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SEPTEMBER/OCTOBER 1989

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Professional Bulletin 1-89-8

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PROFESSIONAL BULLETIN

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Cover: ***Aviation Applied Technology Directorate (AATD): Transitioning Technology to the Fighting Force. The directorate conducts vital aviation technology research for worldwide rotorcraft applications. Cover illustration by Lynn Spangler, Visual, Engineering and Graphics Branch, AATD, Ft. Eustis, VA.***

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This month the *Aviation Digest* welcomes the U.S. Army Aviation Systems Command's Directorate for Maintenance, St. Louis, MO, as a regular departmental feature. "Aircraft Component Management," by Colonel Gary D. Johnson, Director of Maintenance, introduces this new department.

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Lieutenant General Ellis D. Parker

As I left Ft. Rucker, AL, and the U.S. Army Aviation Center to become Director of the Army Staff, I felt tremendous pride in all aspects of Army Aviation. I am exceedingly proud of the contributions made by those who pioneered Army Aviation's inception in the 1940s. I am equally proud of those who, through their imagination and hard work, contributed continuously through the 1950s into the 1980s to the eventual creation of the Aviation Branch in 1983.

In the last few years, we have made giant strides in force modernization with the fielding of the AH-64 Apache attack helicopter and the OH-58D observation helicopter. We have developed and implemented the Army Aviation Modernization Plan and the Army Aviation Personnel Plan. The former provides a logical method to modernize the Army's aviation assets; the latter, a roadmap to ensure Aviation Branch officer and enlisted personnel are trained and managed to improve professional development and combat readiness.

We have become responsible for all Branch functions, including aviation logistics—with the absorption of the U.S. Army Aviation Logistics School—and air traffic services—with the incorporation of the Army Air Traffic Control Activity—into the Aviation Branch. We have updated our force structure and doctrine as well as tactics, techniques and procedures. We have reviewed our training needs and modified our programs of instruction to increase efficiency in keeping with fiscal demands for the training of aviators, crewmembers, maintenance personnel, air traffic controllers and flight operations specialists.

I am especially proud of the outstanding men and women who served with me while I was chief of the Aviation Branch. I am sincerely grateful for your support and wish each the very best as you continue to take part in the growth of the Branch. Air Assault!

Major General Rudolph Ostovich III

As Army Aviation prepares to enter a new era of the nineties, it is appropriate to pause and give tribute to Lieutenant General Ellis D. Parker and the masterful leadership he provided the Branch during its formative years. Assuming the position of Branch Chief shortly after its formation, General Parker had the difficult task of pulling together the pieces of Army Aviation. He did so with a clear understanding of mission, a vision for the future, genuine commitment and superb leadership. The development and refinement of doctrine, institution of officer and NCO basic and advanced courses, and consolidation of air traffic control and aviation logistics within the Branch are but a few examples of his truly magnificent accomplishments. Together, the Parkers made Ft. Rucker a superb place to live and work. Certainly all Branch members join me in wishing them success and happiness for the future.

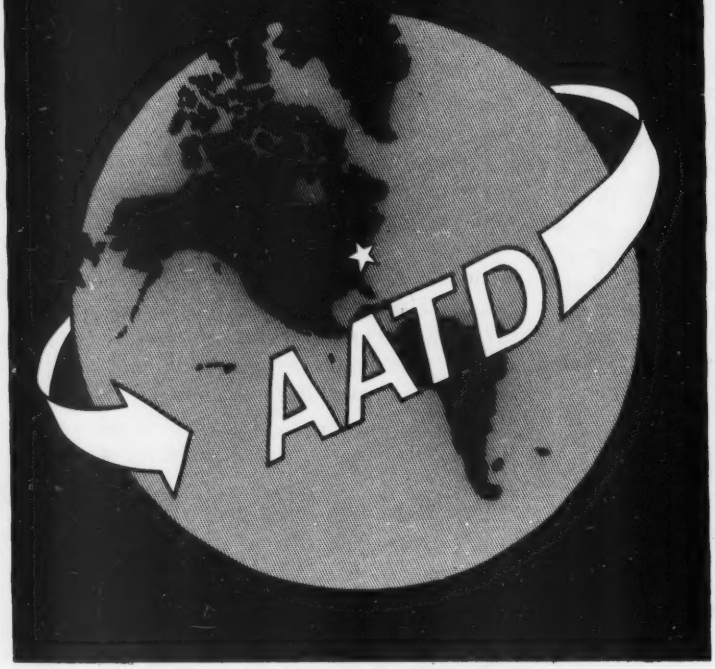
Now that the Aviation Branch has matured for several years, we can look forward to a period of even greater contribution to the Army and to the national defense, despite inevitable constraints on resources. Army Aviation has ably demonstrated "value added" to virtually all aspects of military operations representing relevant combat power, whether performing traditional missions as part of forward deployed forces in Europe or assisting drug interdiction efforts along our sovereign borders. We cannot, however, rest on our laurels.

Now, more than ever before, we must build on past successes to achieve a new dimension of excellence. There is work to be done in training, doctrine, leader development, force design and materiel requirements in order to realize Army Aviation's full potential. Together, we will succeed.

TRANSITIONING TECHNOLOGY TO THE FIGHTING FORCE

Colonel John E. Kempster

Colonel Kempster was Director/Commander, U.S. Army Aviation Research and Technology Activity, Aviation Applied Technology Directorate, Fort Eustis, VA, when he wrote this article.



THE JULY 1983 issue of *Aviation Digest* devoted several pages to an article by Colonel Emmett F. Knight, then commander of the Army's Applied Technology Laboratory, Ft. Eustis, VA. With time comes change. The organization is now known as the Aviation Applied Technology Directorate (AATD), a field activity of the U.S. Army Aviation Systems Command (AVSCOM), St. Louis, MO. It is still at Ft. Eustis, and still conducts vital aviation technology research for worldwide rotorcraft applications. This update article focuses on the AATD mission and functions, and on several key programs of promising technology with near-term readiness implications and far-term air vehicle potential. The mission of the directorate is accomplished through inhouse studies, use of resources of academic institutions and commercial research organizations, close cooperation with other Government agencies, and contracts with aerospace industrial firms.

As for its organization, one technical division, which includes six technical areas; two support divisions; a contracting division; a quality assurance office; and an office of counsel make up the directorate's team, which operates with a complement of about 325 military and civilians. Two-thirds of these are engineers, technicians and other professionals associated directly with research activities. The directorate is organized to handle a large, varied and continuous workload and maintains a wide degree of flexibility to assure an ability to meet unprogramed projects. A significant inhouse capability exists for structural and ballistics testing. Facilities also are available for a number of additional aeronautical and systems investigations.

TECHNICAL SERVICES DIVISION

At the heart of AATD's inhouse research and development (R&D) program is its *Technical Services Division*, the cornerstone of AATD. The group is small, skilled and highly responsive to the needs of Army Aviation—in terms of research, development, test and evaluation (RDTE) program support and, increasingly, in terms of high-priority operational matters.

The division has a wide array of skills and talents that can be formed quickly into support teams for flight test programs, crash and wire-strike testing, infrared testing, ballistics testing, special aircraft modifications, structural integrity tests and a gamut of other subjects. Add to this several basic ongoing functions, such as a top notch computer operation; technical library; technical editing; technical illustration and visual aids; and a photo lab; and you round out a strong and integrated capability.

From the simple selection and installation of strain gauges on a helicopter bellcrank to the design and implementation of a real-time flight test telemetry system—the *Instrumentation Branch* is at the forefront of technology in Army Aviation R&D testing. Taking a closer look, the branch designs circuits; does buildup and test at the bench level; configures, calibrates and installs transducers, components and instrumentation packages; performs data acquisition, reductions and analysis; provides onsite test teams; and writes test reports. A large pool of instrumentation hardware and equipment is maintained. An analog/digital data translation system is the hub of a highly computer-oriented and closely knit group of electronic engineers and technicians. Other major resources include: a waveform analyzer; a digital data reduction system; a decommutator system; a digital data control and acquisition system; a pulse coded modulation telemetry system; an internal calibration lab; and an instrumentation bus and van for mobility in the field.

The *Engineering Design and Graphics Branch* is the real-world extension of the AATD project engineering staff. Whether it is a straightforward bracket design, or a full-blown drawing and documentation package for a system procurement, the staff transforms ideas, concepts and sketches into working designs, drawings and specifications necessary to fabricate hardware end items and for practical implementation of research, development, test and evaluation objectives. Coupled into this group of aeronautical engineering technicians are the audio/visual team and the motion picture/still/video photography team. The teams consist of technical illustrators, visual information specialists and scientific photographers.

The automatic data processing world of AATD abounds with a proliferation of personal computers, computer aided design systems, dedicated minicomputers for special applications and a large VAX 11/780 system as the primary tool. Routine access to large IBM and Computer Data Corporation mainframes and specialized software at AVSCOM and the National Aeronautical and Space Agency (NASA), Langley Research Center, Hampton, VA, is gained through the VAX. The *Computing and Information Systems Branch* provides the planning, acquisition, resources management, programing and systems design, and much of the related services through a team of highly motivated mathematicians and computer specialists. Although the orientation of this group is technical, they also provide full business and management information system support to the directorate. No matter if the job is a simple FORTRAN program to solve an equation, or the design of a large database management system, this team has the talent and the drive to get results.

The fourth branch is the *Experimental Fabrication Branch*. Last, but certainly not least, this element of AATD's inhouse support team works "magic" on a regular basis. It is not an exaggeration to say that, given time and materials, these talented model makers, machinists, sheet metal mechanics, welders and other specialists can handle just about anything pointed their way. They are creative, experienced and totally oriented toward getting the job done. While the shops are not rich in state-of-the-art production equipment, nonetheless they make their impact through individual abilities and adequate machinery. Projects have varied widely over the 38-year history of this organization at Ft. Eustis. The shops have built air cushioned vehicles, paragliders, full-scale helicopter wind tunnel models, shallow draft boats and the first helicopter armor kits used in Vietnam; test facilities, displays, major test rigs, jigs and fixtures; mockups and working models of aviation equipment; aviation intermediate maintenance (AVIM) systems toolsets; armor kits for the UH-60A Black Hawk; full-scale visual modification kits for the National Training Center, Ft. Irwin, CA; and an endless list of others. Their proud attitudes and products reflect the best traditions of AATD.

Taken collectively, the Technical Services Division provides a streamlined and capable support team for AATD's inhouse R&D program.

STRUCTURES

The primary mission of AATD's structures technical area is to direct both exploratory and advanced development in airframe, rotor and control systems, and landing gear structures. This mission is accomplished through—

- Development of structural design criteria and analysis techniques, which will result in improved material applications and design concepts that provide components with improved strength, fatigue life and durability in the field.
- Demonstration of improved military characteristics such as safety, survivability, reliability and maintainability.

The *Structural Integrity and Rotor Components Team* is responsible for—

- Efforts that relate to the development of improved structural design criteria, loads analysis techniques, and advanced rotor and control design concepts.
- R&D efforts related to improved airframe and landing gear design.

Manufacturing methods and technology programs are directed at the development of improved methods for the cost-effective production of aircraft structural components and are conducted by the *Airframe and Manufacturing Technology Team*. The AATD Structures Laboratory is equipped to provide project support in static and fatigue testing, vibration testing and nondestructive evaluation.

Recently, the Structural Integrity and Rotor Components Team has been involved with developing a Helicopter Structural Integrity Program (HSIP). The HSIP will be a set of formal regulations, standards and specifications. These products of the program should assist program managers to assure that structural integrity receives attention early in the concept definition phase and is an integral part of the design, testing and operation of their systems. As such, the HSIP will lower the probability of discovering structural integrity problems late in the development cycle or after the system is fielded. To correct problems at that time is extremely costly and may result in an adverse readiness impact on the fleet.

Erosion of rotor blades in both sand and rain environments has been a persistent problem over the years. To protect the rotor blades, erosion protection strips typically are used on the outboard section of the blade. Both metallic and nonmetallic erosion protection strips are used in service today. Metallic strips provide good protection in rain, while nonmetallic strips provide good protection in a sand environment. (See "Meeting the Challenge of Sand and Rain Impacts on Main Rotor Blades" on page 14.)

Activities in the *Airframe and Manufacturing Technology Team* have centered largely around the developing and testing of the Advanced Composite Airframe Program (ACAP) helicopters. The ACAP objective was to develop and demonstrate the cost and weight advantages of applying advanced composite materials and design configurations to the helicopter airframe structure. ACAP helicopters fabricated by Sikorsky Aircraft and Bell Helicopter were first flown in 1984 and 1985, respectively. During the past 4 years, the three airframes fabricated by each con-

FIGURE 1: Sikorsky Advanced Composite Airframe Program (ACAP) helicopter after a 38-foot-per-second vertical drop at 10 degrees pitch and roll.

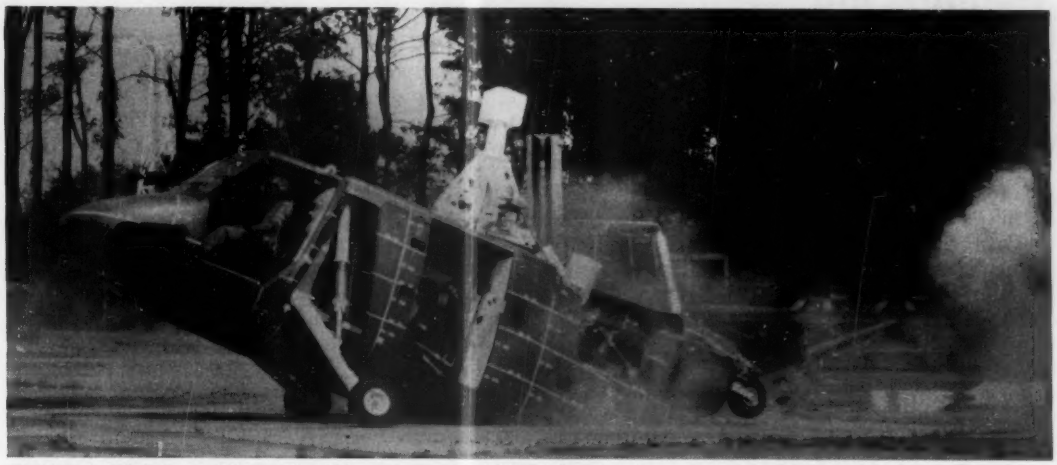


FIGURE 2: Bell Advanced Composite Airframe Program (ACAP) helicopter after a 41-foot-per-second vertical drop and a 27-foot- per-second forward airspeed at 14 degrees pitch and roll.

tractor have been used for test and evaluation of a variety of military characteristics. Included are crashworthiness, repairability, survivability, lightning strike protection, internal acoustic noise, weapons interface and avionics compatibility. The static test airframes were each drop-tested at NASA/Langley to evaluate crashworthiness characteristics. Shown in figure 1 is the Sikorsky ACAP after a 38-foot-per second (fps) vertical drop at 10 degrees pitch and roll. The Bell ACAP shown in figure 2 was drop-tested at a 41-fps vertical sink speed and a 27-fps forward airspeed with 14 degrees pitch and roll.

As a part of the structures technical area's inhouse R&D efforts in airframe dynamics and vibrations, each ACAP flight test vehicle will be shake-tested dynamically. The results will be correlated with finite element predictions. Figure 3 shows the Bell flight test vehicle in the vibration test facility. These efforts will provide an increased understanding of current design and analysis techniques and identify required improvements for the development of composite airframe designs with improved vibration characteristics. The ultimate objective of the research is to develop methodology which, when used, will result in an aircraft design with improved vibrational characteristics. This design will reduce vibration-induced fatigue of the structure and the occupants.

FIGURE 3: Bell flight test vehicle in the vibration test facility.

PROPULSION

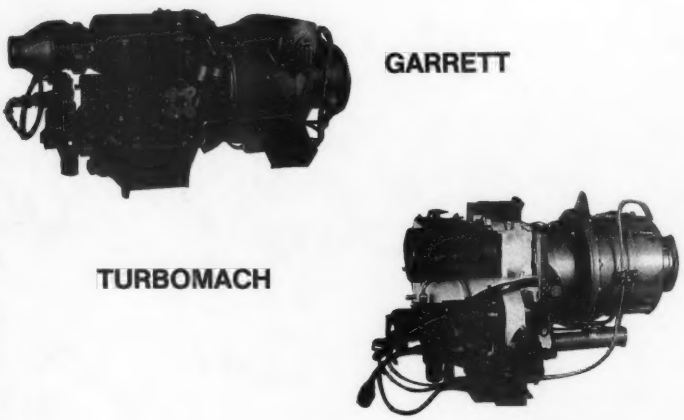
The propulsion technical area encompasses extensive component and demonstrator engine technology. These efforts are aimed primarily at providing validated propulsion technology for future and current Army and Department of Defense (DOD) applications. Past major efforts include: the 1,500 horsepower demonstrator engine, which transitioned into the T700; the advanced technology demonstrator engine, which transitioned into the T800; and the Army/Navy modern technology demonstrator engine, which transitioned into the Navy P7-A aircraft. Current efforts are focused on providing advanced propulsion for the 21st century DOD vehicles under the Triservice Joint Technology Advanced Gas Generator Program and subsequent Engine 21 Program. Specific highlights of current programs are as follows:

Tricommand multipurpose small power unit (MPSPU). Based on coordination with other Army Materiel Command subordinate commands, it was determined that there was a potential requirement for a small power unit for applications to aircraft, armored family of vehicles and vehicular environmental control units. The technical directors of AVSCOM, U.S. Army Tank Automotive Command and Belvoir Research, Development and Engineering Center signed a memorandum of understanding defining the common interests; and AATD initiated the competitive MPSPU program. The program covers a power range from 50 to 100 plus horsepower. It will offer significant improvements in fuel consumption, cost, and improved reliability, availability and maintainability compared to existing power units. Engine testing is underway and mockups shown in figure 4 have been made available to the light helicopter experimental teams to perform a secondary power system analysis using the advanced technology power units. Comparative performance of the MPSPU with existing units is shown in figure 5.

Adaptive fuel control. Flight tests of the adaptive fuel control culminated a successful effort that began in 1981. The effort was a feasibility investigation of concepts that optimized engine control. The adaptive electronic fuel control is a step beyond existing electronic controls. The term "adaptive," used herein, simply means that the control is capable of modifying its characteristics while in operation to optimize engine control. In addition, the idea was to use the available computational power of the existing microprocessor. The total development involved flight simulation with a 6-degree of freedom flight dynamics computer model; closed-loop bench testing of actual hardware; real-time, pilot-in-the-loop, fixed-base simulator with actual electronic hardware in-the-loop (world's first); engine test; ground tie-down test; and, finally, flight test.

Flight tests have been completed for both the Sikorsky S76 with the Chandler Evans control and the Bell 222 (680 rotor) with the Lucas control. Another world's first occurred in November 1987 when the first Ada-programed electronic fuel control was flown in the Bell 222. Army test pilots also flew the machines and had a very favorable evaluation. The Bell 222 had a Decoupled Rotor Speed Control System that automatically controlled rotor

FIGURE 4: Multipurpose small power unit mockups.



speed during autorotative descent, which greatly reduces pilot workload. A laser weapons simulator was used on the Sikorsky S76 to evaluate the control's performance improvement for target acquisition.

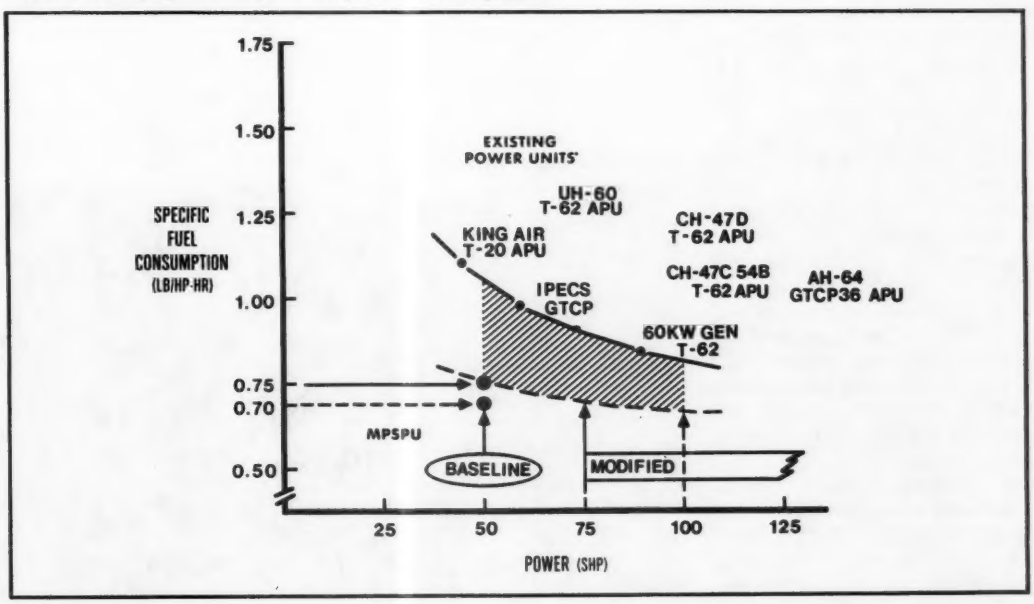
Benefits with the adaptive control were realized in the following areas:

- Engine surge avoidance and recovery.
- Cooler starts.
- Torsional drive train damping.
- Improved one-engine-inoperative response.
- Rotor droop reduction in high performance maneuvers.
- Lower cruise fuel consumption by automatic variation of rotor speed.
- Improved weapons platform stability.
- Reduced pilot workload.

Triservice joint turbine advanced gas generator/Engine 21. Since the fielding of the T700 engine, AATD and other Government-sponsored engine component research efforts have resulted in significant improvements in aerothermodynamic and material capability. A new engine incorporating these improvements could result in a 20-percent reduction in fuel consumed, 40-percent improvement in power-to-weight, and 40-percent improvement in specific power compared to the current T700 series. Under a triservice program, the critical gas generator core technology will be validated. This technology will be available for later integration into a complete engine, "Engine 21," for future Army and DOD applications.

The program was funded by all three services with initiation to begin in fiscal year (FY) 1989. The program is part of the DOD Integrated High Performance Turbine Engine Technology initiative whose objective is to double aircraft propulsion capability by the year 2000. The Army has been designated as the selection authority for Phase I of the program. AATD is the agency responsible for coordination and issuance of the triservice request for proposal and subsequent evaluation administrative support.

FIGURE 5: Multipurpose small power unit performance comparison.



SAFETY AND SURVIVABILITY

This technical area conducts programs that will increase rotorcraft combat survivability and Army Aviation combat mission effectiveness by:

- Reducing the detection of aircraft, considering such factors as radar, infrared, and noise or visual signatures.
- Passively hardening the aircraft against directed energy threats (laser and high-powered microwave) as well as nuclear, biological and chemical warfare threats (electromagnetic pulse, blast and contamination).

Emphasis is placed on achieving required protection with minimum effect on aircraft mission accomplishment. The effectiveness of Army Aviation also will be improved through ballistic hardening of the aircraft. This is done by reducing the vulnerability of the crew, passengers, fuel system, components and structure against hits from potential projectiles and from warhead fragmentation. Increased mission readiness will be realized by improving flight safety and crashworthiness of aircraft. This should decrease the number and severity of Army Aviation mishaps. In turn, this will result in fewer fatalities and injuries, conservation of materiel and improved aircrew morale.

Army Aviation combat sustainability and effectiveness will be improved through the conduct of vulnerability and survivability analyses leading to the identification of specific vulnerabilities for various threats of current fleet and conceptual aircraft systems, and subsystems, thus providing the necessary data to support:

- Definition and application of vulnerability reduction concept.
- Development of improved survivability design criteria.
- Proper consideration of vulnerability issues in new aircraft system development.
- Definition of the most cost-effective approach to system vulnerability reduction.

To do this, the safety and survivability technical area—

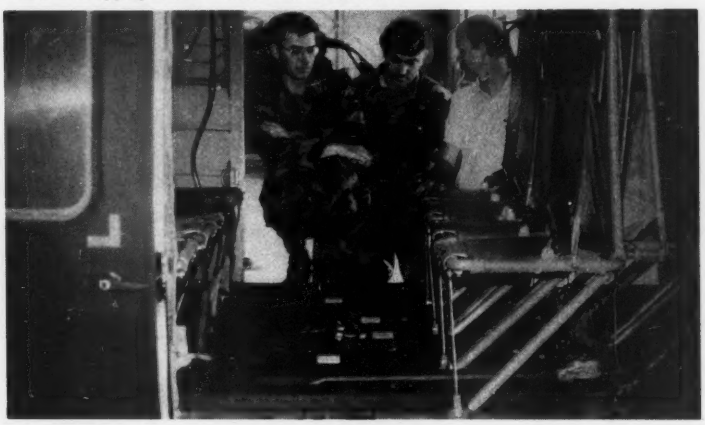
- Maintains expertise in current and projected threats to Army aircraft survivability.
- Defines realistic survivability design criteria for current and future aircraft systems.
- Develops technology to optimize the design and integration of aircraft survivability components to enhance their effectiveness while minimizing effect on aircraft performance.
- Takes advantage of new and changing technology of materials, computational techniques, fabrication methods and design methodology.

Three of the programs within AATD's safety and survivability technical area have as an overall objective improved helicopter survivability. These programs include applique armor, an alternate floor seating system and nonpneumatic composite wheels.

The applique floor armor is a kit form of protection for the cargo space of the UH-60A. To date, the system has been subjected to ballistic and load testing in the laboratory and is presently being evaluated by a number of military units. The kits can be installed without structural modification. Generally, this program has three objectives:

- Ballistic protection from small arms.

FIGURE 6: Applique floor armor kit on the UH-60.



• Installed weight equal to one combat equipped troop.

• Relatively low cost.

Over the next year, field testing and a final design will be completed (figure 6).

The second of these programs is actually an extension of the applique armor project. The alternate floor seating system is a program to provide ballistic floor protection, seat belt type restraint and crash attenuation. The primary stimulus for this program is to allow the field commander the option of carrying more combat troops in a UH-60A helicopter. With the present system, 11 troops are carried in seats that weigh 19 pounds each. The objective of this alternate seating is to allow up to 22 combat troops to be transported. Over the past 18 months, a system was designed, fabricated and field tested. The results of this effort are being evaluated by user/developer agencies (figure 7).

A helicopter wheel system that can replace the existing pneumatic wheels, on a one-for-one basis, with a pneumatic system is being investigated to improve ballistic tolerance. At present, a full-scale, one-piece composite hub, rim and tire is being fabricated, which promises light weight with increased overall toughness. The wheel has been designed to duplicate existing UH-60A main tire static and dynamic properties. It will first be tested in the laboratory to prove the design concept before subjecting it to a series of flight tests (figure 8). Other approaches to increase ballistic tolerance of helicopter wheels have included a self-sealing tire lining and filled tires.

FIGURE 7: Alternate floor seating equipment being installed.

FIGURE 8: Nonpneumatic wheel system.

RELIABILITY, MAINTAINABILITY, AND MISSION TECHNOLOGY

The mission of this technical area—besides the pursuit of technology base efforts in reliability and maintainability diagnostics, ground support equipment and cargo handling—also includes engineering development and pre-nondevelopmental item acquisition activities in cargo handling and ground support equipment.

To reduce no-fault removals and maintenance downtime, for a number of years, we have been considering diagnostic technology advancements. The most recent of these has been the application of artificial intelligence and expert systems for aviation maintenance. Three separate programs have been accomplished. Each of them showed extremely positive results from the standpoint of reducing operation and support costs and improving aircraft availability. One of these, called the "Intelligence Fault Locator," accomplished by McDonnell Douglas Helicopter Company, is going to be continued into a battalion-level demonstration at Ft. Hood, TX, in the fall of 1989. The expert system uses a knowledge base derived from multiple sources such as aircraft designers, maintainers, operators, subsystem specialists, etc. It provides operational maintenance personnel with easy access to this information through an interactive process. The expert system application to maintenance is attractive for a number of reasons. But the fact that the system is nonintrusive, it has no attachments to the aircraft and one expert system can be used as support equipment for six to eight aircraft was the prime driver.

In our ground support equipment area, we have fielded a prototype of the resheltered AVIM nondivisional shop sets. In this prototype, a revised tool list was reviewed and upgraded, as necessary, and assembled into an 8 by 8 by 20 foot, one-side-expandable shelter to form each shop.

We are now initiating a similar inhouse project for the resheltering of the AVIM divisional shop sets. We have conducted an inhouse project for the design, fabrication and field evaluation of the new aircraft tool set for introduction into the Army Aviation system. This new tool set, besides upgrading the quality of the tools, will result in a reduced number of tools in the inventory as well as in the capability of performing an instant inventory on the toolbox itself. It is anticipated that this tool set will be in the field in about a year.

Also, in support of the Ground Support Equipment Weapons Systems Manager at AVSCOM, we are undertaking the acquisition and fielding of two prototypes of a flexible engine diagnostic system, which will replace the current outdated test stand. It is anticipated that 26 of these test sets will be procured by the Army. Our intention is to have the first two of these units in the operating Army in early 1990. Each test stand, with the use of adapters, will be capable of conducting diagnostic tests on all Army Aviation engines.

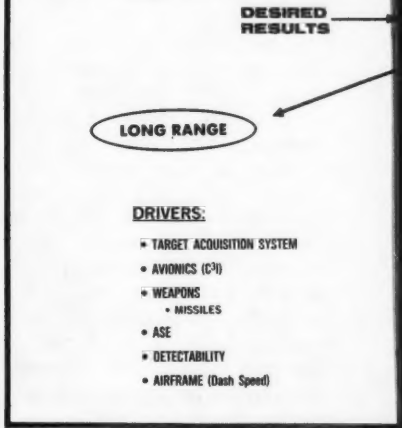
WEAPONIZATION

The weaponization technical area formulates and conducts Army Aviation weapons development programs. To accomplish this mission, weaponization technology programs have been structured to correct identified operational deficiencies and fill technological voids in target acquisition, fire control, weapons, weapon system/aircraft integration and man/machine interface.

Primary effort currently addresses the development of an effective air-to-air combat capability. Emphasis will be on target acquisition/missiles for long-range encounters, 2.75-inch rocket flechette warheads for medium-range encounters and turreted weapon/fire control technology for short-range encounters (figure 9).

The multisensor fusion demonstration was recently conducted

FIGURE 9: Effective air combat capabilities.



to determine target acquisition performance of an automatic target recognizer (ATR) system. This system fuses information of multiple sensors and information data sources. The program was structured to address the critical issues of ATR performance, search times and extent, and system implementation. Two multisensor testbed systems were evaluated in a tactically realistic environment to determine sensitivity to Army operational mission scenarios under various lighting and weather conditions as well as battlefield obscurants and debris. The incremental effect of each information source on total system performance was evaluated as was the current maximum achievable level of automatic target recognizer (figure 10). This program was conducted in close coordination

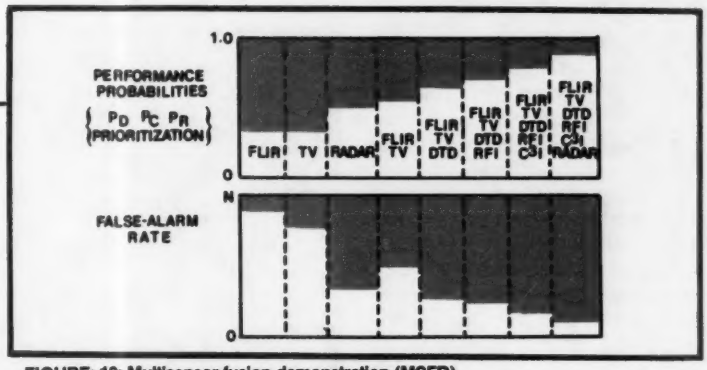


FIGURE: 10: Multisensor fusion demonstration (MSFD) evaluation of sensor/information contribution.

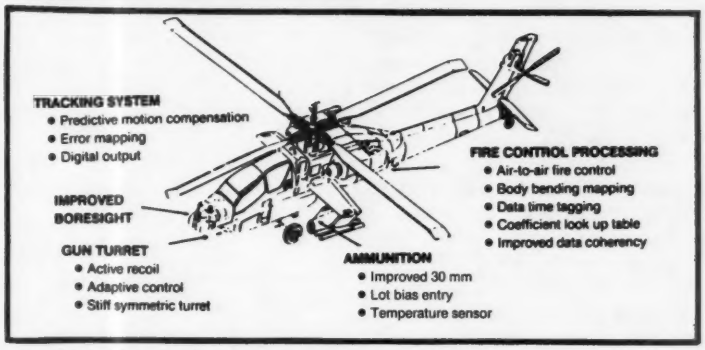


FIGURE 11: Integrated air-to-air weapons testbed aircraft.

with the Center for Night Vision and Electro-Optics, U.S. Army Communications-Electronics Command, and Harry Diamond Laboratories, U.S. Army Laboratory Command.

The integrated air-to-air weapon program will evaluate advanced automatic cannon, turret-pointing technologies and appropriate advanced technologies. Evaluation will be in target tracking, air-to-air fire control and ammunition. Appropriate technologies will be integrated into an AH-64 testbed aircraft and evaluated during weapon firing flight testing during FY 1991 (figure 11). The information gained from this program will assist in improving air-to-air effectiveness of both existing and developmental aircraft. Technology insertion can be accomplished through product improvement programs on existing aircraft with data available to assist the combat and materiel developers in defining future air-to-air combat requirements and weapon system capabilities. This program is being conducted in close coordination with the U.S. Army Armament Research, Development and Engineering Center, U.S. Army Armament, Munitions and Chemical Command.

The systems integration technical area has two major focuses in R&D:

- Integration of subsystems to enhance total systems.
- Integration of advanced flight controls to improve mission performance.

Advanced technology development must deal with the integration of the research disciplines such as structures, aerodynamics and propulsion, applying their synergistics benefits to mission-related objectives of survivability and lethality. The complexities of integration can no longer wait until full-scale engineering development, but must be addressed early in the R&D cycle. The two program descriptions that follow indicate how AATD efforts address Army Aviation needs.

Advanced digital/optical control system (ADOCS). In November 1981, AATD awarded a contract to Boeing Vertol to design, fabricate and flight demonstrate an ADOCS for helicopters. Digital control laws and optical flight control hardware were developed to allow mission tailoring of the flight control system and investigate the feasibility of fly-by-light technology. The ADOCS flight control architecture, figure 12, illustrates the triply redundant primary flight control system that provides reliable but unaugmented control. The automatic flight control system augments helicopter stability and provides mission tailored flight control functions. Flight testing and multiple user demonstrations (76 pilots) validated the feasibility of a digital optical control system and documented the reduced pilot workload promised by the system and mission tailored flight controls.

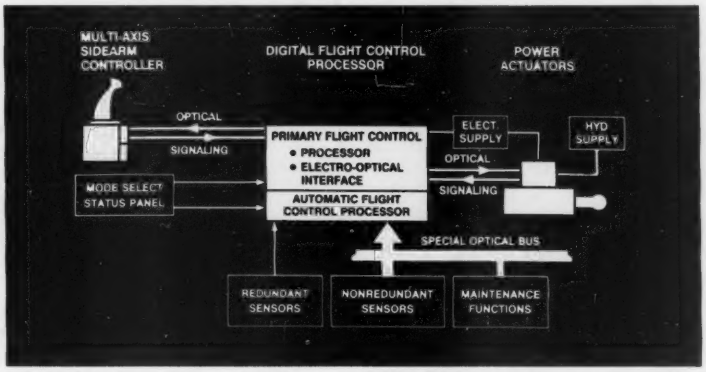


FIGURE 12: Advanced Digital/Optical Control System (ADOCS) demonstrator concept.

FIGURE 13: ADOCS modified UH-60 "Light Hawk."

The ADOCS demonstrator, a modified UH-60A dubbed the "Light Hawk," figure 13, became the first aircraft to successfully demonstrate a completely operational, full-authority, fly-by-light control system. The program has shown that fiber optics, flight control laws tailored for specific mission tasks and single-handed sidearm controller configurations are viable options for next generation helicopters.

Air-to-air combat test (AACT). AATD has conducted four one-on-one AACTs during the period April 1983 to April 1987 (figure 14). These tests evaluated various Army fleet helicopters, as well as other selected "state-of-the-art" helicopters, in an environment

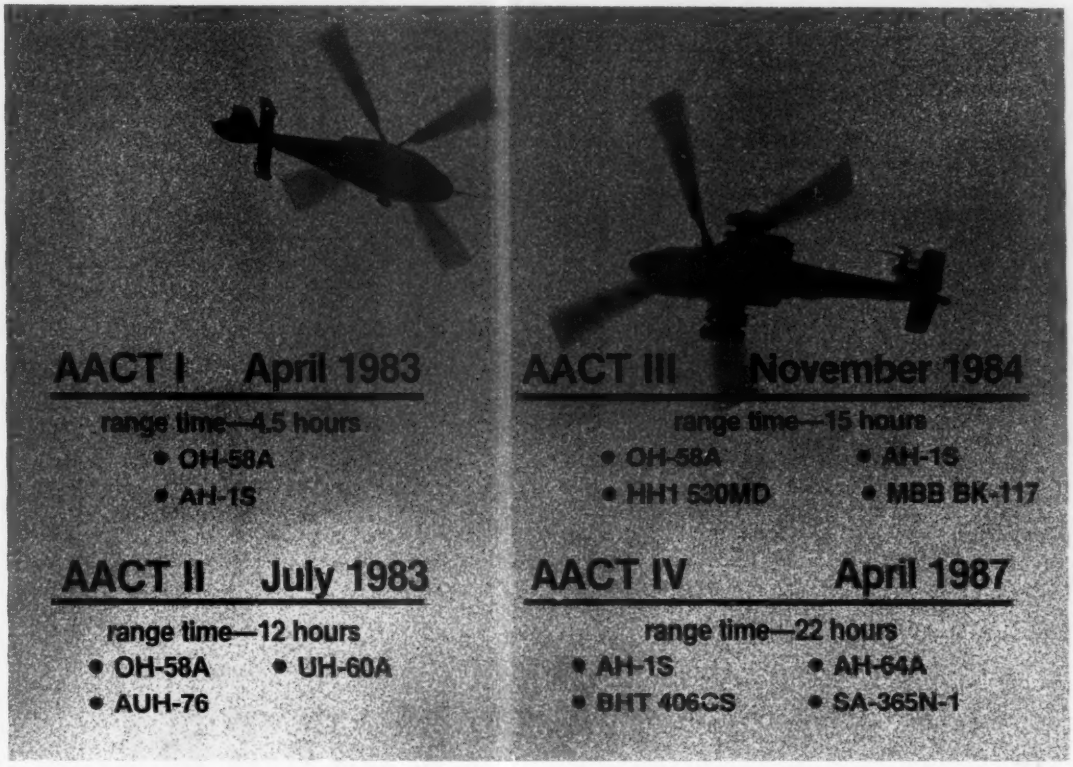


FIGURE 14: Air-to-air combat tests.

designed to simulate air-to-air gunnery combat engagements. These tests at the Naval Air Test Center, Patuxent River, MD, evaluated maneuverability and agility issues. The tests also established an engineering database for both fixed forward and turreted gun configured aircraft. This database will permit the formulation of general conclusions as to attributes, capabilities and shortcomings of rotorcraft in the air combat maneuvering environment. Desirable aircraft characteristics can then be incorporated into current and future rotorcraft to meet the air-to-air combat challenge.

AATD has its roots back to the very start of Army Aviation. It is developing modern technologies targeted to provide an effective combat multiplier for Army aircraft on future battlefields. No matter where the challenge, the Army and Army Aviation will be better prepared for operations under adverse conditions in a hostile environment because of AATD's exploratory and advanced development programs.

MEETING THE CHALLENGE OF

SAND

illustration by David Osborne

AND RAIN

IMPACTS ON MAIN ROTOR BLADES

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ARMY HELICOPTERS must operate in an extremely wide range of environments throughout the world. Providing optimum blade erosion protection is a difficult task. The blade leading edge must withstand rain and sand particle impingement as well as the impact of foreign objects such as brush or small tree branches. In addition, interface with composite blade structure and leading edge deicing must be considered. The most damaging effects are produced in the high-velocity tip regions of the blade leading edge.

The Aviation Applied Technology Directorate (AATD), U.S. Army Research and Technology Activity, Ft. Eustis, VA, and its predecessor organizations have been addressing rotor blade erosion since the early 1960s. Studies of the metallic

and nonmetallic materials then available were made and polyurethane leading edge boots on CH-34 Choctaw rotor blades were tested. A significant amount of work has been done and significant literature is available covering various categories of aircraft erosion. A large number of programs have addressed the problem of aircraft erosion including many materials investigations. High-speed flight through rain seriously erodes wing leading edges, windshields, radomes and infrared transmitting windows. This requires the problem of rain impingement to be addressed by other military services as well. Engine turbine blades are susceptible to erosion also.

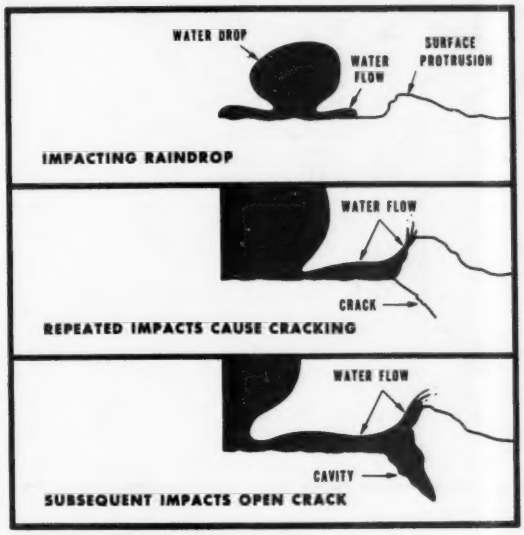


FIGURE 1: Rain erosion process.

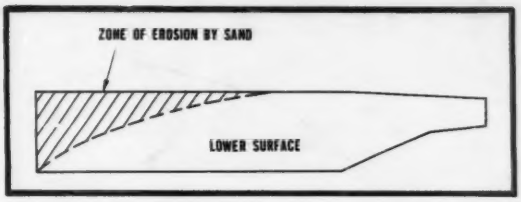


FIGURE 2: Pattern of sand erosion.

Designing for Erosion Protection

Rain droplets and sand particles each have different erosion processes. Sand erosion acts like an abrasive, scraping the blade surface; it is detrimental to hard metallic surfaces, whereas rain erosion is more detrimental to nonmetallic surfaces because of the larger deformations of the material surface upon impact. The region of wear on the blade is also different for each environment. Rain damage of the nonmetallics is limited to the airfoil leading edge until debonding takes place. Sand erosion is more severe aft of the leading edge and erodes a much larger portion of the surface. Figure 1 shows the rain erosion process. Figure 2 shows a typical sand erosion pattern for a rotor blade. The erosion resistance of the two major categories of materials is shown in figure 3.

The design of an erosion system for a rotor blade is a compromise between protection against rain or sand erosion to obtain the best possible overall system. With the development of new composite rotor blades, new materials and concepts are being developed that may provide a better solution. A multilayered system is one of the new concepts that looks promising. This system is being investigated by AATD to provide an optimum erosion protection system. The multilayered

FIGURE 3: Erosion resistance of protection systems.

EROSION	PROTECTION	PERFORMANCE
SAND	METALS*	POOR
	NONMETALS**	GOOD
RAIN	METALS*	GOOD
	NONMETALS**	POOR

*TYPICAL METALS – ALUMINUM, STAINLESS STEEL, TITANIUM, NICKEL PLATE

**TYPICAL NONMETALS – POLYURETHANE, (ESTANE, P0855, L-101), ABRASIVE-RESISTANT PAINT/TAPE

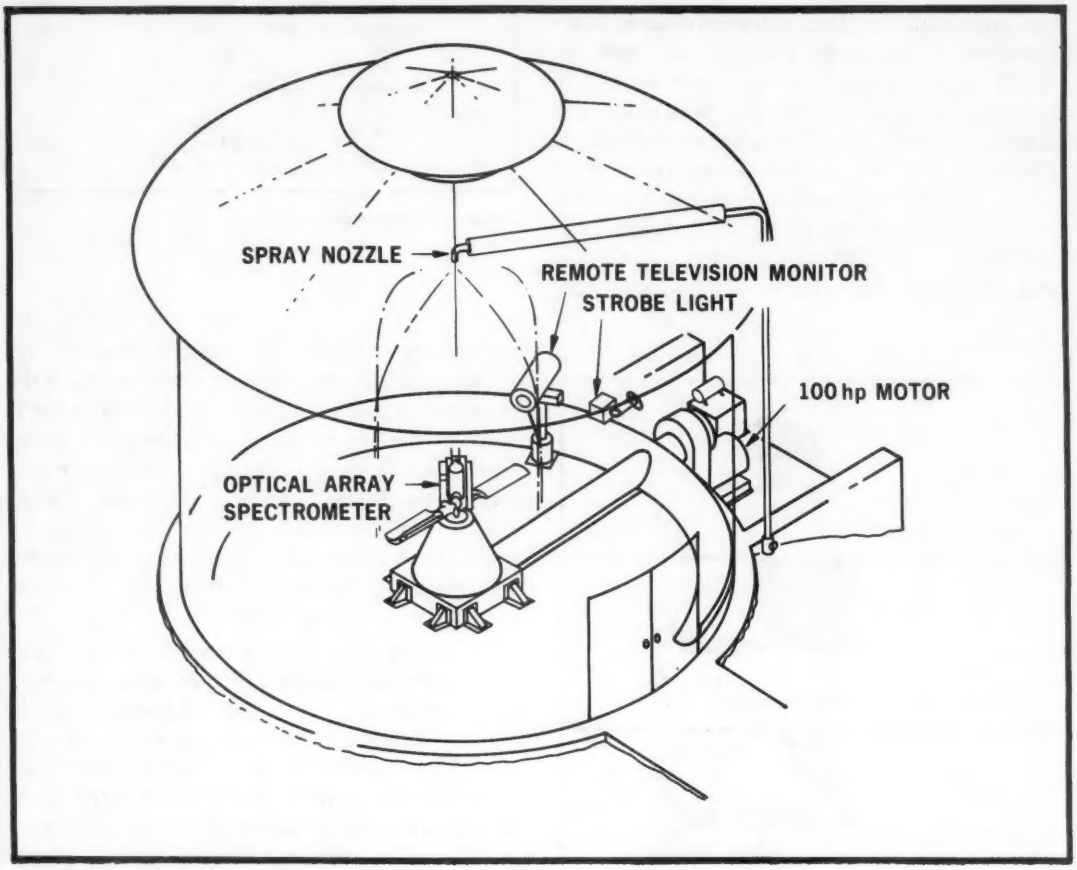


FIGURE 4: Blade erosion test facility.

concept works by having a soft outer layer to absorb the initial impact. The subsequent layers become progressively stiffer, dissipating internal stresses caused by the droplet impact.

Previously there has been no specific design criteria document to assist the designer of Army helicopters. However, a recent AATD program has developed a design document—"Design Criteria for Army Helicopter Rotor Blade Erosion Protection Systems." This document defines the environmental conditions for a typical Army rotor blade and establishes minimum requirements for the design and wear life of erosion protection systems. A new program to develop a multilayered system will use this document to determine if the system is useful, realistic and should be proposed as a formal design specification.

Testing Erosion Protection Systems

Testing new erosion protection systems provides another challenge in obtaining data with operational aircraft. This challenge occurs because it is not possible to quantify ambient rain or dust conditions in which the test aircraft is operating and hard to find test locations where frequent natural rainfall is available. Use of the CH-47 Chinook helicopter icing spray rig provides a measured amount of water to a helicopter in flight. Whirling arm devices are used to make comparisons between various materials and types of

erosion systems. The latest test stand developed in a recent AATD program is shown in figure 4.

With the development of the design criteria document, a test procedure entitled "Qualification Testing of Erosion Protection Systems" was developed. This document outlines a general test procedure that will point out the parameters of importance in erosion testing. A baseline is set forth from which a detailed test plan can be developed for each erosion protection system being qualified. The specific details of each test plan should be established by mutual agreement between the end user and supplier. This test procedure will be used in the new multilayered program to determine its usefulness, whether it is realistic and whether it should be used in conjunction with the proposed design specification.

Besides specific erosion testing, other MIL-STD-810 environmental conditions, such as temperature and humidity extremes, must be addressed.

Multilayered Erosion Protection System

A planned AATD multilayered Erosion Protection System Program will—

- Evaluate new materials.
- Develop a design specification for a multilayered system.
- Analyze the configuration for application to the K747 AH-1S Cobra main rotor blade.

Representative specimens will be fabricated and the specimens will be whirl tested and environmentally tested. A full blade system will be designed and 10 systems will be fabricated. The systems will be installed on blades and the blades flight tested. Figure 5 shows a blade with a multilayered erosion protection system.

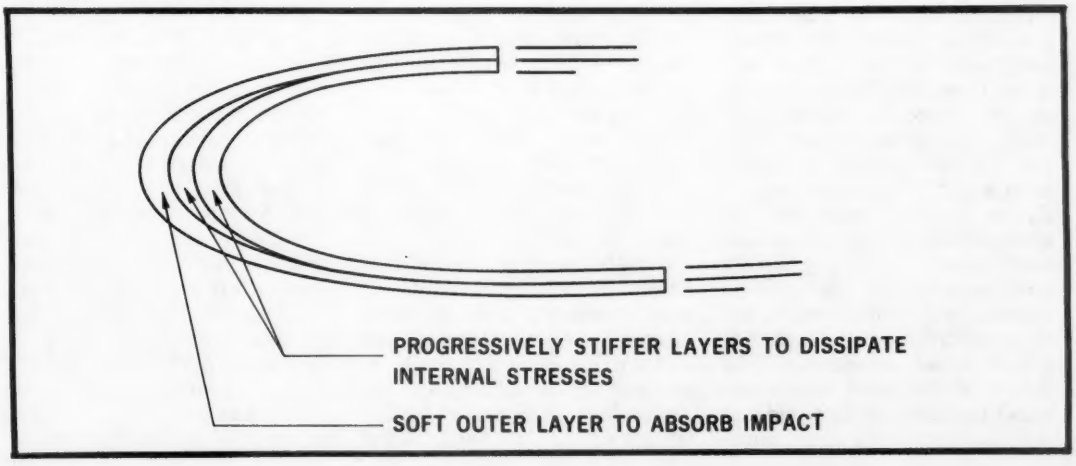
Conclusions

Much work has been done in addressing rotor blade erosion by many organizations. AATD has developed a design criteria document, new test procedures, new analytical techniques and new test equipment.

Erosion guards developed for the K747 blade had good rain erosion properties but hydrolysis deterioration occurred in hot, humid climates. AATD-sponsored research has resulted in indications that a multilayer polyurethane system represented an improved approach.

Further development of a multilayered erosion guard system that will apply directly to the K747 blade and generally apply to other operational blades and future aircraft, such as the light helicopter experimental, is planned.

FIGURE 5: Multilayered system.



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LONGBOW

WHAT ARE Army Aviation's warfighting deficiencies? To answer this question Army Aviation was directed to conduct an armor/antiarmor study to evaluate aviation force capabilities against an armor force. The results of this study highlighted Army Aviation's difficult task to detect, engage and defeat enemy targets during the day, night, adverse weather and through battlefield obscurants. Currently under development for the AH-64 Apache is an advanced target acquisition system that addresses these deficiencies. The AH-64 is the most impressive attack helicopter in the world and with Longbow its current capability for defeating an evolving and advancing threat will be enhanced many times over. The following is a brief description of the Longbow system, its characteristics and the program status.

The Longbow is a heliborne millimeter wave (MMW) fire control radar (FCR) and radio frequency (RF) fire-and-forget missile seeker for the HELLFIRE modular missile system (HMMS). Longbow is shown in the photograph above as it will be installed on the AH-64 helicopter. Longbow, formerly the airborne adverse weather weapon system (AAWWS), has been under development by Aviation Applied Technology Directorate (AATD) since 1981. It is currently in the proof-of-principle (POP) phase of development under the U. S. Army streamlined acquisition process.

From 1981 through 1985, the AAWWS went through a series of preliminary studies and demonstrations performed in critical technology areas. The results of those demonstrations clearly showed that the system was ready for further development.

Following the successful completion of the critical technology demonstrations, the U. S. Army appointed the AAWWS product manager, resident at AATD, to prepare the AAWWS for the POP program phase. An inprocess review was held in August 1985 for an AAWWS tactical demon-

photos courtesy of Martin Marietta Westinghouse

Longbow is a fire control radar and HELLFIRE missile seeker for the AH-64 Apache helicopter.

strator and best technical approach for a fully operational tactical system. That effort was followed in August 1986 with the award of the POP contract. The objectives of the POP program are as follows:

- Successfully demonstrate the ability to integrate Longbow as a brassboard configuration on the AH-64 helicopter.
- Demonstrate the mission modes of operation of the FCR and RF HELLFIRE missile.
- Perform live missile firings at ground targets from the Longbow demonstrator AH-64 helicopter platform.
- Demonstrate that Longbow meets the performance requirements of the POP demonstrator specification.
- Demonstrate development/production prove-out transition readiness.

As a system, Longbow consists of an MMW FCR, an integrated RF interferometer and the RF missile seeker for the HMMS. The Longbow will be employed by attack helicopter battalions and cavalry squadrons, using the AH-64 or light helicopter experimental (LHX) weapons systems, to engage and destroy enemy forces. Longbow offers the capability of conducting day and night battle in adverse weather and with battlefield obscurants present. In addition, Longbow offers a fire-and-forget capability that complements the semiactive laser (SAL) HMMS. The fire-and-forget capability enhances survivability by reducing exposure time. The FCR operates in ground, air or combined targeting modes that allow for target detection, location and instantaneous prioritization of all targets displayed to the Longbow operator. The effectiveness of the Longbow-equipped HMMS is specified to have a probability of kill greater than, or equal to, that of the current SAL HELLFIRE missile. These features, along with other system characteristics, assure increased survivability, lethality, fightability and the ability to perform continuous operations under adverse weather and battlefield conditions.

The Apache will be modified as necessary to incorporate the Longbow. Those modifications will include: additional environmental cooling, an upgraded fire control computer, extended forward avionics bays, improved electrical power supplies, another data bus, and an upgraded cockpit and weapons management system.

The current POP program is scheduled to end its technical period of performance this fall. At that time, Longbow will enter into a 10-week early user test and experimentation period. During this period, the combat developer will be able to perform preliminary tests and experimentation to provide a basis to formulate future tactical operations using the Longbow. The initial design phase (IDP), development/production proveout, will transfer the Longbow from AATD and POP to full-scale development. At that time it will be managed by the target acquisition and designation system/pilot night vision sensor project manager within the Aviation Program Executive Office with support from the HELLFIRE project manager. Although program management will change at the conclusion of the POP technical period of performance, the POP phase will be concurrent with the commencement on the IDP effort, which started in August 1989.

On 14 July 1989, the commander of the U. S. Army Aviation Center, Ft. Rucker, AL, briefed the user requirements to the Army Systems Acquisition Review Council, which the Vice Chief of Staff, Army, chaired. The VCSA approved the initial design phase for Longbow. He approved development of four prototype aircraft to be used for testing and evaluation. In May 1990, after all initial design data are analyzed, the VCSA will chair the next decision milestone that will authorize full-scale development.

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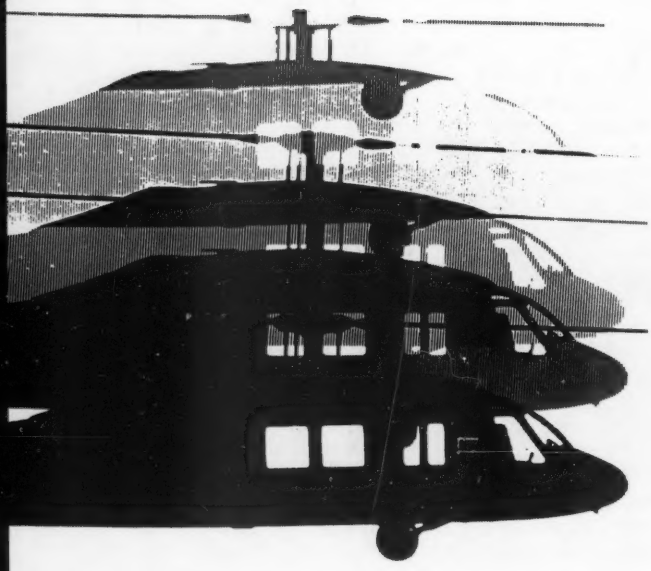


MODERN DAY training and tactical employment requirements for the U. S. Army helicopter dictate that a large percentage of operations occur in the low-speed, low-altitude flight regime. These operations reduce margins of safety normally associated with higher airspeed and higher altitude operations in case of an emergency. This increased probability of accident occurrence, coupled with the lack of an inflight egress capability, makes design for crashworthiness essential for Army helicopters.

The UH-60 Black Hawk and the AH-64 Apache, the first two U. S. Army helicopters designed to be crashworthy, have accumulated sufficient field experience to permit an early assessment of the performance of their crashworthiness design features. It can be stated without reservation that these design features have saved many lives and many aircraft. Of course, one does not obtain any increased capability without an impact upon system weight and cost. A calculated projection of life-cycle cost of design for crashworthiness shows a return on investment in 4 to 6 years during peacetime operations. However, it would occur quicker in wartime. This does not include the important humane aspect of saving lives, which

CRASHWORTHY HELICOPTERS

cannot be adequately priced, or the increase in morale and performance of aircrews who know they have protection in case of a crash. A big factor in the cost savings results from the landing gear design requirement of no fuselage contact for a 20-foot per second landing, an impact that would be a total loss accident for the AH-1 Cobra, UH-1 Huey and OH-58 Kiowa series aircraft. The resulting increase in readiness is another important factor that was not priced because it is difficult to quantify.

The Aviation Applied Technology Directorate (AATD) is recognized as the world leader in the formulation of crashworthiness design criteria for rotary wing aircraft, and in the development of components that provide crashworthiness. The AATD was instrumental in getting crashworthiness design requirements specified in the utility tactical transport aircraft system and advanced attack helicopter prime item development specification that led to the UH-60 and AH-64, respectively. The "users" happiness with the UH-60's level of crashworthiness has had the very significant result of having this level specified in the light helicopter experimental specification.

The AATD formulated Military Standard 1290A (MIL-STD) "Light Fixed and Rotary Wing Aircraft Crash Resistance," which is in fact, a crashworthiness design guide. MIL-STD-1290A addresses the following key areas that must be considered in designing a helicopter to conserve materiel and provide the necessary occupant protection in a crash:

- Crashworthiness of the structure assures that the structure has the proper strength and stiffness to maintain a livable volume for the occupants and prevents the seat attachments from breaking free.
- Retention strength assures that the high mass items such as the transmission and engine do not break free from their mounts and penetrate occupied areas.
- Occupants' acceleration environment provides the necessary crash load absorption by using crushable structures, loadlimiting landing gears, energy-absorbing seats, etc., to keep the loads on the occupants within human tolerance levels.
- Occupants' environment hazards provide the necessary restraint systems, padding, etc., to prevent injury caused by occupants flailing.
- Postcrash hazards, after the crash sequence has ended, provide protection against flammable fluid systems and permit egress under all conditions.

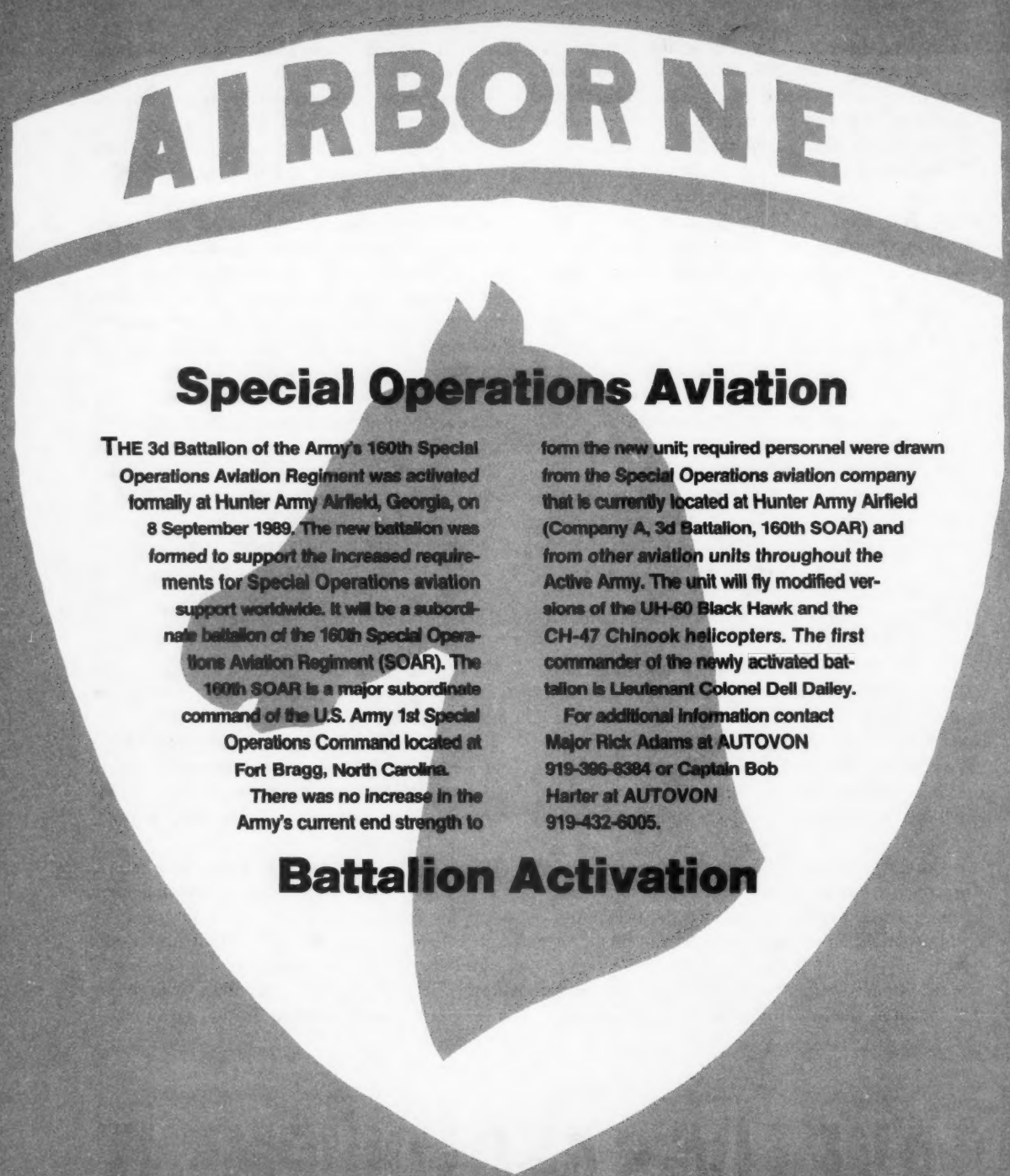
The AATD is actively engaged in the development of improved components of crashworthiness that include landing gear, structure, seats, restraints and fuel system. With the application of the AATD crashworthy fuel system (CWFS) to Army helicopters, what had been the greatest killer in survivable crash impacts is no longer an issue. Since 1970, when the first CWFS retrofit occurred, the Army has not experienced a single thermal fatality in a potentially survivable accident in a CWFS-equipped aircraft.

Crashworthiness design has been applied to Army helicopters and has matured to a point where tangible benefits are being realized.

For crash impact conditions, which would have been considered nonsurvivable for older fleet helicopters, UH-60 and AH-64 crashes are occurring with some occupants not even being injured, much less being killed.

There should be no doubt on the positive return on investment of the Army's decision to implement design for crashworthiness in its helicopters. In addition, the importance of developing crashworthy aircraft is also recognized by our North Atlantic Treaty Organization allies who have agreed to crashworthy standardization agreements.

SAVE LIVES AND EQUIPMENT



Special Operations Aviation

THE 3d Battalion of the Army's 160th Special Operations Aviation Regiment was activated formally at Hunter Army Airfield, Georgia, on 8 September 1989. The new battalion was formed to support the increased requirements for Special Operations aviation support worldwide. It will be a subordinate battalion of the 160th Special Operations Aviation Regiment (SOAR). The 160th SOAR is a major subordinate command of the U.S. Army 1st Special Operations Command located at Fort Bragg, North Carolina.

There was no increase in the Army's current end strength to form the new unit; required personnel were drawn from the Special Operations aviation company that is currently located at Hunter Army Airfield (Company A, 3d Battalion, 160th SOAR) and from other aviation units throughout the Active Army. The unit will fly modified versions of the UH-60 Black Hawk and the CH-47 Chinook helicopters. The first commander of the newly activated battalion is Lieutenant Colonel Dell Dailey.

For additional information contact Major Rick Adams at AUTOVON 919-396-8384 or Captain Bob Harter at AUTOVON 919-432-6005.

Battalion Activation

Occupational Health and ATC

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THE ISSUES

Air traffic control (ATC), as an occupation, and its effects on health have been under study for the last 20 years. Millions of dollars have been spent in this research effort. There has been much roaring and howling from two corners of opposition. One claims that ATC duties place the controller at risk for a large assortment of illnesses. The most commonly quoted effects have been diabetes, ulcers, hypertension, psychiatric illness and stress disorders. The other viewpoint has been countering with claims that ATC duties have no effect on health. The media has certainly provided a fair amount of coverage, especially during the Professional Air Traffic Controllers' Organization (PATCO) strike in the early 1980s. This publicity popularized the concept that ATC duties are associated with certain illnesses, therefore placing the safety of air traffic in jeopardy.

With my "retrospecto-scope," I have reviewed these 20 years of study and sorted out apparent valid information. I have had time to study the strengths and weaknesses of the landmark studies that have survived the tincture of time. The outcome of this review is not what I expected.

COMPARING POPULATIONS

Most of the problems with interpreting the results of studies come from the problem of comparing populations. This problem directly influences our interpretation of the conclusions drawn by various researchers studying how ATC affects health.

For example, my wife recently read to me claims from a nutrition article that eating pumpkin seeds will reduce one's chances of getting prostate cancer. All of this was based on the fact there is very little prostate cancer in Transylvania and the local inhabitants there eat more pumpkin seeds per capita than any other region of the world. I would say that there is a weak argument for any relationships between the cause (eating pumpkin seeds) and the effect (protection from prostate cancer). What if all of the pumpkin seed eaters in this culture were women? They do not have a prostate gland. What needs to be done is to compare the risk of developing prostate cancer in Transylvanians between male pumpkin seed eaters and male nonpumpkin seed eaters. If there is a difference, then it is a little easier to believe that maybe there is a protective effect.

Occupational Health and ATC

When reviewing the cause and effect relationship of diseases, one has to be careful with whom one compares air traffic controllers. This individual also has to be on guard to eliminate any source of biases that may distort statistical conclusions.

For example, I read one study that stated air traffic controllers had significantly more hypertension than commercial pilots. The problem is that we are not comparing two similar populations. This study was based on the review of who had waivers for hypertension. The study, however, did not adjust for the fact that in the 1970s most pilots with hypertension were permanently grounded. During that time, most air traffic controllers with hypertension received a waiver. So already there is a built-in bias, artificially elevating the numbers of air traffic controllers with hypertension when compared to hypertension of pilots. The risk for hypertension also increases with age. This study did not adjust for the fact that the average air traffic controller was older than the average pilot. This study again artificially elevated the numbers when comparing these two populations. So the real question not answered by this study: Are air traffic controllers at increased risk for developing a new case of hypertension than pilots of a similar age?

DIABETES

Fortunately, air traffic controllers do not develop diabetes (high blood sugar) any more than other average professional workers in the United States. If an air traffic controller should develop diabetes, the chances for getting a waiver for this condition are good. Individuals can reduce risk for developing diabetes by eating well-balanced diets to maintain weight within 10 percent of the desirable weight for their build and age and participating in regular aerobic exercise for 20 minutes three times a week.

ULCERS

Air traffic controllers are at slightly higher risks than aviators for developing peptic ulcer disease of the stomach and small intestine. The highest risk occurs in young air traffic controllers at high-volume traffic centers. But the chance of an air traffic controller developing peptic ulcer disease is still about the same as the general population. Also, the risk for developing peptic ulcers seems more strongly correlated with the controller's personal habits; excess consumption of nicotine and alcohol; and whether the controller is experiencing financial or marital difficulties.

There have been a few epidemics of ulcers noted in groups of air traffic controllers during controller/management disputes: "sick-outs" in the early 1970s and the PATCO strike in the early 1980s. Similar epidemics have been seen in other groups, such as coal miners and steel workers, during similar walkouts and strikes when the patient's entire life was disorganized.

The risk for developing ulcers can drop by abstinence from nicotine products and alcohol; prudent use of aspirin and aspirin-like products, such as Motrin (Advil, ibuprofen); and by taking positive steps to reduce or avoid conflicts with job management and the pressures of family or financial difficulties.

HYPERTENSION

Hypertension (high blood pressure) is a common malady of our society, and it has been said that hypertension is a major health problem among air traffic controllers. Television and movies certainly have portrayed the intense air traffic controller hunched over a console, madly puffing on cigarettes. As the weather turns rotten, the individual reaches for the bottle of antihypertension medications.

Actually, air traffic controllers, far less likely to develop hypertension than the average American, are no more likely to develop hypertension than aviators. It is true that the average air traffic controller with hypertension is slightly younger than the average aviator with hypertension. Air traffic controllers who do develop hypertension are more likely to be cigarette smokers or overweight.

The risk for developing hypertension can be reduced by not adding salt to food; abstaining from nicotine products; eating a well-balanced diet to maintain weight within 10 percent of the desirable individual weight and age; and participating in regular, aerobic exercise for 20 minutes three times a week. Air traffic controllers with hypertension can have their condition controlled by taking medications and modifying lifestyles. Most controllers will continue to work with waivers.

STRESS AND PSYCHIATRIC ILLNESS

The casual visitor at an air traffic control facility is impressed by what seems to be an overwhelming task. Controllers quickly flash their cursor all over the screen; type smartly on the console keys; coordinate with other controllers; and talk frequently on the radio with both hands free to accomplish other simultaneous tasks. Again, movies and television have exaggerated this impression.

Air traffic control work could be classified as stressful, because it demands concentration and precision and is accompanied by shift work. There is no universal definition of occupational stress. But since the tasks of ATC are quantifiable, ATC as a profession is amenable to studying the effects of occupational stress. One can count the number and types of traffic handled in a given period under "X, Y, Z" conditions. Of course, the researcher should not overlook other sources of stress not related to job tasks, such as administration, medications, and family and monetary stability.

The psychological and biochemical responses of air traffic controllers on the job have been studied extensively. It is documented that an air traffic controller's adrenaline blood level increases as the volume of traffic increases. But this is a natural response and not necessarily harmful. Long term air traffic controllers have no different alterations in their body responses than other professional shift workers. The amount of occupational stress varies from one ATC facility to the next. But overall, air traffic controllers are no more likely to develop stress-related psychological dysfunction as a result of their jobs than any other professional group. The degree of anxiety on the job correlates more strongly with the degree of unresolved personal conflicts at home or with management than with the volume of traffic handled. Certainly there always will be air traffic controllers who develop a fear of handling traffic, become overly anxious at the console or get "burned-out." But this is no more likely to happen doing ATC tasks than any other average professional job. The risk for leaving the ATC field because of stress-related psychological disorders is more strongly correlated with the controller's skill, aptitude, experience and personality than with the volume of traffic handled.

The challenge is what most air traffic controllers like about their job. They usually dislike routine paperwork and administration. Tasks presumed stressful and anxiety provoking by the onlooker are instead a source of considerable challenge and professional satisfaction among controllers. A majority of air traffic controllers find that the fast-paced, instant decisions overcoming the pressures and adversities of the weather actually prevent boredom. They also find efficient management of traffic as enjoyable and rewarding. My own observations in ATC facilities have convinced me of this phenomenon, where a sudden burst of heavy traffic turns a room full of bored-looking controllers into an interacting, smiling group as they skillfully handle the situation.

More than half of the air traffic controllers who develop serious psychological problems can return to their duties with counseling and time. Successful occupational stress reduction programs have been developed and can be applied to the ATC field as part of an overall preventive medicine program.

SUMMARY

Overall, the air traffic controllers, like the aviators, are healthier than the average person. After careful study, most of the myths about how air traffic control affects health have been disproved. Air traffic controllers who do develop chronic illness are more likely to have unhealthy lifestyles. Any individual can significantly reduce the risk for developing many chronic diseases by abstaining from nicotine products, alcohol and other harmful substances; maintaining a sensible weight through proper nutrition; and maintaining aerobic fitness.

The Aviation Medicine Report is a monthly report from the Aviation Medicine Consultant of TSG. Please forward subject matter of current aeromedical importance for editorial consideration to U.S. Army Aeromedical Center, ATTN: HSXY-ADJ, Fort Rucker, AL 36362-5333.

AVIATION PERSONNEL NOTES

Commissioned Officers' Issues

The Deputy Chief of Staff for Personnel (DCSPER) recently decided to return the Army captain promotion board from twice a year to an annual board. As a result, the September 1989 board was cancelled. The next board is scheduled for March 1990.

As a result, about 850 first lieutenants in year group (YG) 87 could complete their active duty service obligation (ADSO). They could do this without being considered for captain and without being selected for conditional voluntary indefinite (CVI) status. Officers in the category are YG 87, other than Regular Army, first lieutenants with an initial ADSO (obligated volunteer) of 3 years and a date of rank between 1 April 1988 and 31 March 1989.

The DCSPER decision could affect some officers, but should not affect any aviators because they incurred an ADSO of 5 years for their flight training. They should all understand two boards will no longer meet for competitive category promotion to captain and for CVI. Instead, the board will meet annually.

Officers who are not aviators and fall in this category will get short-term extensions until 31 July 1990 so they may be considered for captain/CVI.

Noncommissioned Officers' Issues

A recently approved change to AR 611-201, *Enlisted Career Management Fields and Military Occupational Specialties,* announced the elimination of the 66-series military occupational specialty (MOS). The Basic Noncommissioned Officer Course (BNCOC) now incorporates technical inspector (TI) training. Implementation begins in October 1989. According to a recent message from the assistant commandant, U.S. Army Aviation Logistics School, Ft. Eustis, VA, soldiers holding the 66-series MOS get credit for BNCOC training. Soldiers must have attended TI training between October 1983 and January 1990.

On 3 May 1989, the DCSPER approved an extension of the time line for conversion of MOS 93H, Air Traffic Control (ATC) Tower Operator and 93J, ATC Radar Controller to 93C, ATC Operator. Additionally, the U.S. Total Army Personnel Command (PERSCOM) has provided further reclassification guidance. Under the provisions of this extension, soldiers who hold MOS 93H or 93J must complete the conversion by 23 March 1990. Military occupational specialty 93C will be awarded to controllers in the following categories:

- Those who have completed advanced individual training (AIT) for MOS 93C.
- Dual-rated controllers (tower and radar).
- Those who entered in a unit cross-training program that results in a dual rating.
- Those who completed AIT for former ATC MOS 93B and 93K.
- Soldiers in grade sergeant first class(P) or above holding MOS 93H or 93J.

All other soldiers holding MOS 93H or 93J must complete transition training before reclassification. Individuals may request transition training packets from the following address: Commander, U.S. Army Training Support Center, ATTN: ATIC-IPC (Ms. Newbill), Ft. Eustis, VA 23604-5166, AUTOVON 927-5410. Soldiers not reclassified by

l April 1990 will be identified and reclassified to meet Army needs.

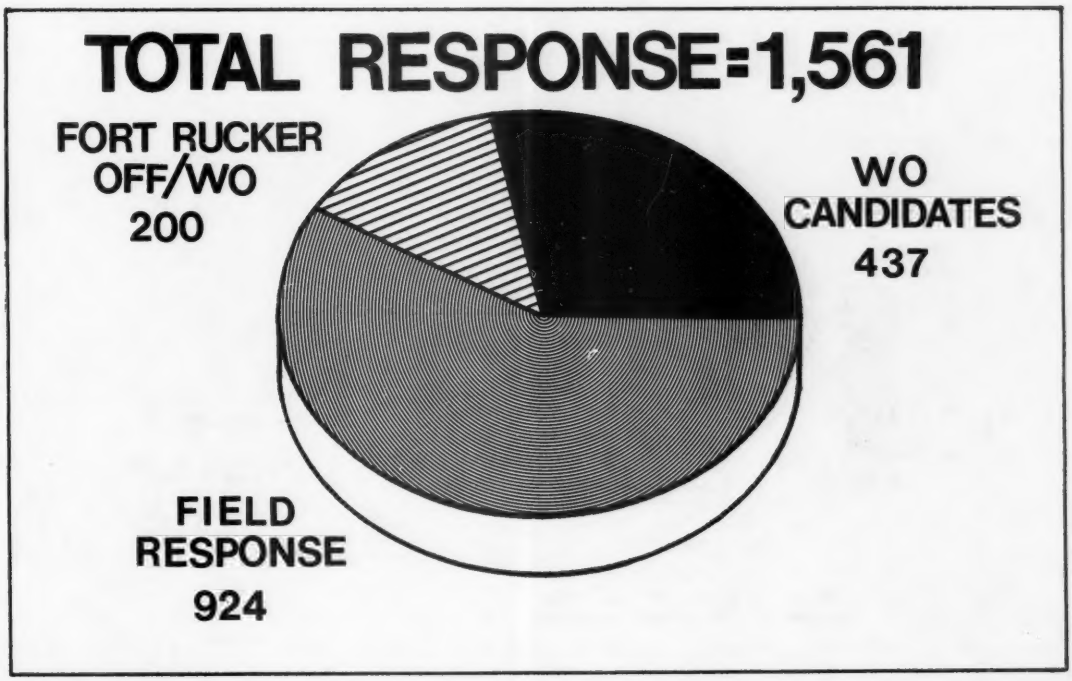
The commander, PERSCOM, recently sent messages to the field to reconfirm the criteria for awarding the Aircraft Crewman Badge: All soldiers who successfully complete a course of instruction that leads to the award of an MOS in career management field (CMF) 67 will receive the badge upon graduation and award of the MOS. This applies also to soldiers holding MOS 35K, 35L, 35P or 35R. The 35-series MOSs have been rolled into CMF 67.

Aviation Warrant Officer Aviation Branch Insignia Survey Results

The Office of Personnel Systems, Directorate of Aviation Proponency, Ft. Rucker, AL, conducted an informal poll in the March 1989 issue of the *Aviation Digest* about warrant officers (WOs) wearing branch insignia instead of WO corps insignia. Historically, this is not a new concept. In the early 1900s, warrant officers in the Mine Planter Service, Quartermaster Corps and Transportation Corps all wore branch-affiliated insignia. Tank Corps WOs were the exception in that they wore an eagle standing on a bundle of arrows enclosed in a wreath. When the Army decided to appoint all WOs at-large, the Army adopted the Tank Corps insignia for wear by all WOs.

WO appointments in the 1950s once again tended to be affiliated with a particular branch of the Army. Branches were queried as to whether or not WOs should again wear branch-affiliated insignia. All branches seemed to agree WOs should be affiliated with a branch; however, since many WOs were still appointed at-large, the proposal for WOs to wear branch insignia was dropped.

The issue of WOs' wearing branch insignia came up again in the 1960s. The Warrant Officer Career Program Study Report in 1966 stated that branch-affiliated insignia for WOs were desirable. The study concluded that WO skills should be asso-

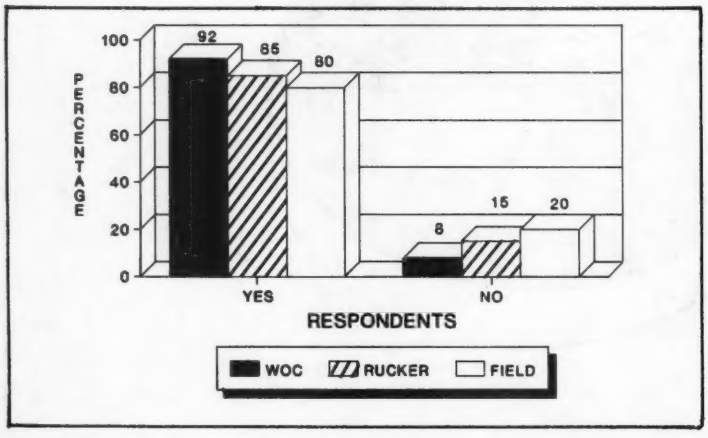


ciated with branches of the Army. Again the recommendation was not implemented primarily because the largest segment of WOs (Army Aviation) did not have a branch with which to affiliate.

The Aviation Branch was formed in 1983. Today, all WOs are appointed to a branch of the Army. Inevitably, the subject of WOs' wearing branch insignia came up again during the Total Warrant Officer Study (TWOS) in 1984. The Chief of Staff, Army chartered TWOS to conduct a comprehensive analysis of the Army WO's role to include utilization, professional development and management. Part of the analysis included a survey of Active and Reserve WOs' examining the current and future role of the Army WO. One of the survey questions addressed the wearing of branch insignia by WOs. About 56 percent of the Army Aviation WOs (AWOs) and 32 percent of the technical service WOs were in favor of wearing branch-affiliated insignia. The Army did not pursue the issue.

The Office of Personnel Systems wanted to determine if the desire to wear branch-insignia has increased or decreased in the last 5 years. The poll clearly revealed an increase. The majority, in all categories, favored the wear of branch-affiliated insignia for Army Aviation and non-Army Aviation WOs. Most felt the Army should approve the wear of branch insignia for all WOs or not at all. As a result, the Aviation Center is considering a proposal to the Army for the wear of branch insignia by all WOs.

The following summarizes the results of the poll. The graphs portray the demographics of those who took the time to respond.

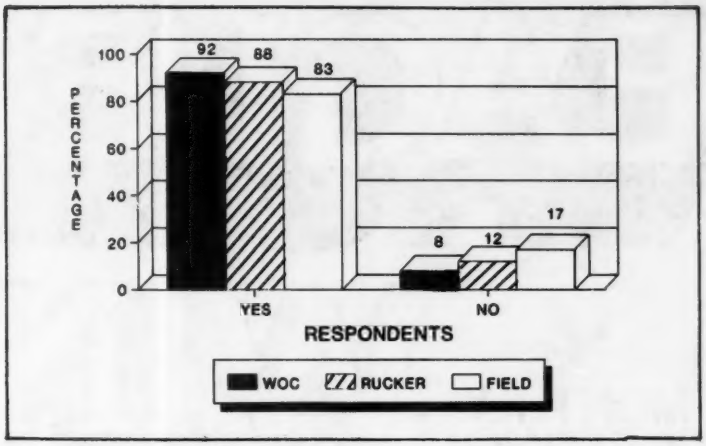


Should AWOs wear Aviation Branch insignia?

YES 85.7%
NO 14.3%

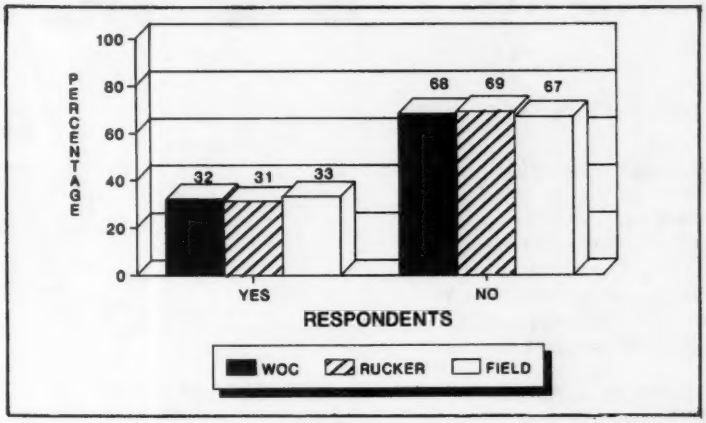
Should all WOs wear their branch insignia?

YES 87.7%
NO 12.3%



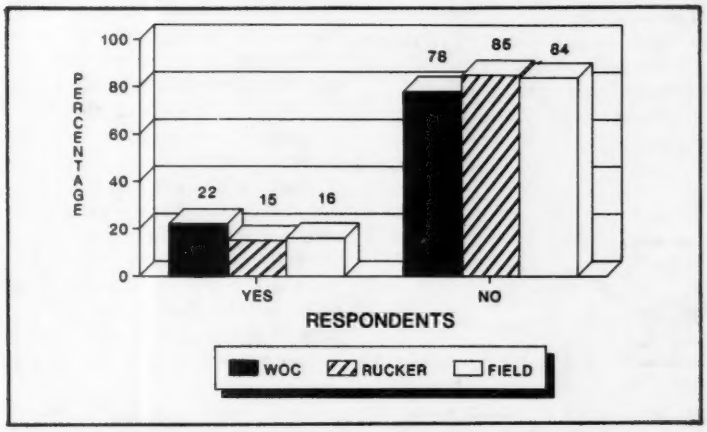
Should insignia wear be left to branch chiefs?

YES 32%
NO 68%



Should insignia wear be left to the unit commander?

YES 17.7%
NO 82.3%



EAGLES, WINGS, AND

MONTHLY WRITING AWARD

With the Wings of an Eagle

The wings of an eagle
Will bear me up one day
As I stand above the valley
Of doubt on some high hill.
Too long I've been bound earthward
By trivial, common things
But now I'll soar upwards
With the wings of an eagle.

The strength of the eagle
Is in me now and
My spirit firm and true,
The cloud of doubt is gone
Replaced by the flight of freedom
In the light that morning brings.
As onward and upward I fly
With the wings of an eagle.

IN THE LEGENDARY tale of Icarus and Daedalus, ancient Greek mythology tells us about mankind's preoccupation with flying. As you may recall, Daedalus and his son, Icarus, offended the King of Crete and were imprisoned. Icarus told his father that they were like birds in a cage. Daedalus told his son that if they were birds they could fly away. With that in mind, Daedalus made two sets of wings of wax and feathers. With the wings tied to their arms, Daedalus and Icarus made their escape attempt. According to the legend, the father's flight was successful, but the son's wasn't. Icarus flew so high that the sun melted the wax, destroying his wings, and he plunged into the sea to his death.

This Greek myth illustrates mankind's desire to escape the bounds of earth and to soar like a bird. Man encountered many frustrations in his attempts to imitate birds, yet the conquest of flight became a continual challenge. He could not rest until it was achieved.

In man's early attempts to imitate the flight of birds, he built an assortment of wings and strange mechanical things. Foolhardy men jumped from cliffs, towers and high buildings in vain hopes to fly; inevitably, their attempts met with disaster. However, after centuries of failure, man was finally airborne. That first flight marked the beginning of a new era. The first manned flight startled the citizens of Paris, France. On 21 November

OTHER THINGS

CW4 Harry W. Sweezey
Directorate of Aviation Proponency
U.S. Army Aviation Center
Fort Rucker, AL

1783, the age-old dream of flying became a reality. On that date two Frenchmen made the first successfully manned flight in a hot air balloon.

The first successfully powered airplane flight was made on the wind-swept dunes at Kitty Hawk, NC. On 17 December 1903, the Wright brothers marked a turning point in aviation history. In their flimsy wood and fabric airplane with its small gasoline engine, Orville Wright achieved man's first powered flight by flying his airplane about 100 feet. On the same day he completed three other flights; the longest was 852 feet.

The U.S. Army Signal Corps originally was responsible for military aviation. The extent of military aviation, at the time, consisted of spotting and sending telegraph messages from balloon baskets. However, because of recent aviation accomplishments, the chief Signal officer established an Aeronautical Division under the Signal Office on 1 August 1907. The purpose of the Aeronautical Division was to study flying machines and the possibility of adapting them for military purposes.

The Army purchased its first dirigible airship for $6,700 and solicited bids for a gasoline-powered airplane. The Army received several bids from which to choose. However, the Wright brothers' bid won the first U.S. Army airplane contract on 10 February 1908. The specifications stipulated that the aircraft had to carry two men at a minimum of 40 miles per hour for a 1-hour flight. The first Army aircraft was purchased for $30,000 on 2 August 1908. The aircraft was a "Flyer Type-A" and was named "U.S. Army Aeroplane No. 1." One of the contracting officers asked Wilbur Wright why some people are so fascinated with flying. Wilbur replied, "I think the desire to fly after the fashion of birds is an idea handed down to us by our ancestors who, in their grueling travels across trackless lands in prehistoric times, looked enviously at the birds soaring freely through space, at full speed above all obstacles on the infinite highway of the air."

It became obvious that military men had that same desire but with the additional desire to achieve a tactical advantage over the enemy.

Aviator Badges

The Army was serious about flying and wanted recognition for those daring men in their flying machines. The chief Signal officer suggested that a badge be designed to show qualification in the air. The badge should represent skill, bravery and the Signal Corps as well. The eagle was suggested because the bird has long stood for strength, skill and bravery. Indians used eagle feathers in their war bonnets as a symbol of power and authority. Eagles, like the Indians, were considered skilled and courageous hunters. All the attributes of the eagle were fitting for the military aviator. If mankind's desire was to imitate the flight of birds, why not then use the largest and most majestic of all the birds of prey for the design?

Introductory planning for a pilot certificate led to the recommendation for both a certificate and a badge design. As a result, a memorandum from the chief Signal officer to the Chief of Staff, Army was submitted on 17 April

illustrations by CW4 Harry W. Sweezey

FIGURE 1: Military Aviator Badge
27 MAY 1913

FIGURE 2: Pilot Badge
15 AUGUST 1917

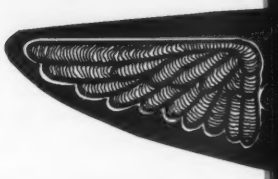


FIGURE 3: Enlisted Pilot Badge
15 AUGUST 1917

1913. The Military Aviator Badge was approved for wear on 27 May 1913 (figure 1). The badge had a decorative top bar with the words "MILITARY AVIATOR" in capital letters. Below the bar, suspended by two outboard links, was a detailed American Bald Eagle. The eagle's wings were outspread in a diving position, and two crossed Signal Corps flags were clutched in its talons. The badge originally was designed to be made in white or silver metal but was produced in 14-karat gold instead. More than one company produced badges. As a result, the badges worn by the recipients varied slightly. One of the requirements for earning the badge was for the individual to attain an altitude of at least 2,500 feet above the ground.

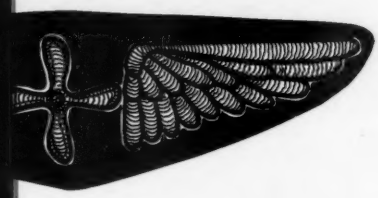
On 18 July 1914, Congress authorized the formation of the Aviation Section of the Army's Signal Corps. The former chief of the Aeronautical Division, Lieutenant Colonel Samuel Reber, was placed in charge of the new Aviation Section. The aviation section was comprised of 60 officers and 260 enlisted men. However, the section was expected to grow over the next few years. The growth would obviously qualify more aviators for the Golden Eagle Award. The cost of the gold badge became a valid concern to the Army. As a result, a recommendation was made to change the design and material to reduce the cost. The approved design consisted of two half eagle wings displayed in full-spread position. Centered between the wings was a shield taken from the 1782 U.S. shield. In the center of the shield were the letters "U.S." taken from the officer's collar device established by General Order No. 22 in 1895. The wings and shield were embroidered in silver bullion; the letters were embroidered in gold bullion, on a dark blue cloth background (figure 2). Each badge had to be individually hand embroidered. As a result, the badges varied in style and shape. The badges were authorized for wear on 15 August 1917.

Enlisted pilots were not authorized to wear the Army Pilot Badge on their chest. Instead, they wore a badge on their sleeve. The badge consisted of two half wings with a fourbladed propeller in the center. The wings and prop were embroidered in white silk on a dark blue felt background (figure 3). These badges were authorized for wear on 15 August 1917. Flight mechanics wore a four-bladed prop in the center of a circle without wings. All other

aviation enlisted personnel wore the four-bladed prop on the sleeve without the wings or the circle.

The third style Military Aviator Badge was approved on 27 October 1917, only a few months after the second style badge was approved. The third style badge was exactly the same as the second, with the addition of a five-pointed star centered directly above the shield. On 21 December 1918, the fourth style badge was authorized. This badge was exactly like the second badge except it was made in oxidized silver and had a pin on the back to attach the badge to the uniform.

Until 1919, there were no standard military specifications for the production of aviator badges. As a result, badges varied widely, depending on the manufacturer. At the end of World War I, the Army directed a standardization program for the design and production of badges. Accordingly, the Army approved the fifth style aviator badge. Herbert Adams designed the standardized appearance. The badge was made of oxidized silver. It was similar to the fourth style with slight variations in design: The stars and "U.S." letters were removed from the shield; the tip of the wings was broader; and the tip of the wings had a slight upsweep. The badge was authorized for wear on 25 January 1919 (figure 4). On 14 October 1921, the designation was changed to "airplane pilot." The title changed again on 10 November 1941 to "pilot badge."



Collar Insignia

The National Security Act of 1947 disestablished the Army Air Forces and created the U.S. Air Force (USAF) as an equal partner with the Army and Navy. The USAF designed new uniforms and insignia for its military personnel; however, the Army Pilot Badge was retained without change. Army aviators continued to wear the same pilot badge until a new design was approved for wear on 2 August 1950 (figure 5).

The Army required another set of wings in 1983. These wings, however, would not be worn as a qualification badge over the uniform pocket. Instead, they would be worn as a collar insignia for members of the newest branch of the Army. Aviation warrant officers were not authorized to wear the new insignia, however. The Secretary of the Army approved Army Aviation as a branch on 13 April 1983. As a result, a branch insignia was needed. The Institute of Heraldry prepared five designs and submitted them to the U.S. Army Training and Doctrine Command (TRADOC) for consideration. TRADOC was responsible for the Aviation Branch Implementation Plan and forwarded a recommendation to Headquarters, Department of the Army for approval of the design. The Chief

FIGURE 4: Army Pilot Badge (Airplane Pilot Badge/Pilot Badge)
25 JANUARY 1919

FIGURE 5: Army Aviator Badge
2 AUGUST 1950

FIGURE 6: Aviation Branch Collar Insignia
7 AUGUST 1983

FIGURE 7: NCO Pilot Cap Insignia
1908

of Staff, Army approved the new Aviation Branch insignia on 7 August 1983 (figure 6).

The Aviation Branch insignia have roots that predate the Army Air Corps insignia and closely resemble the original design of 1908. The first prop and wing design was made of blackened bronze material and the prop and wings were enclosed by a wreath (figure 7). The insignia were prescribed as the cap device for the noncommissioned officer (NCO) pilots of the Aeronautical Division and Aviation Section of the Signal Corps. In 1917 the Army rescinded the cap device and redesigned it for use as a collar insignia for the proposed Air Service Branch of the Signal Corps. Many NCOs continued to wear the old style prop and wing device on their hats even though the device was unauthorized for wear. The hat device was removed in most cases when the new style prop and wing device was produced as a collar device.

A proposal to establish the Aviation Section as the Air Service Branch was approved on 20 May 1918. The Air Service Branch, along with its newly adopted insignia design, became effective on 17 July 1918 (figure 8). The wreath had been removed, and the color was brass rather than blackened bronze. Enlisted members wore the insignia on a disc, and officers wore the insignia without a disc. The Air Service Branch was designated the Army Air Corps on 2 July 1926, and the prop and wing design remained unchanged. The Army Air Corps became the Army Air Forces in June 1941, and the insignia were changed slightly; the new design consisted of wider and thicker wing tips and a larger shoulder. The new insignia were approved by Army Regulation 600-35 on 10 November 1941. The new design was

FIGURE 8: Air Service Branch Insignia
17 JULY 1918

based on the 1919 pilot badge and the Aviation Cadet insignia that were approved for wear on 22 August 1933 (figure 9).

With the threat of war, the Army Air Forces expanded their pilot strength and proposed a change to make enlisted pilots equal in status to warrant officers. As a result, in 1942 Congress passed the Flight Officer Act, which authorized all enlisted pilots of the Army Air Forces to be established in rank precedence above that of the most senior enlisted grade but below that of a second lieutenant. Flight offic-

ers received the rank, pay and allowances provided for warrant officer junior grade. Flight officers wore the prop and wing insignia and warrant officer junior grade bar. The brown on the warrant officer bar was painted blue until a blue and gold bar could be produced sometime later.

Flight officers were not officially considered warrant officers. However, they are the roots of today's warrant officer aviator. Warrant officers during that period of time usually were supply or administrative personnel. They gained their expertise by becoming senior NCOs and were basically rewarded with a warrant for a job well done. Whereas, the flight officer came from various enlisted career fields, selected in different enlisted grades or even from the civilian community. Flight officers were trained in their pilot specialty field and were awarded their bar at the completion of flight training. Both the warrant officers and the flight officers wore the warrant officer eagle as a cap device.

The warrant officer eagle originally was designed for the Tank Corps warrant officer. However, because of branch immaterial design, it was recommended for wear by all warrant officers when the Army decided no longer to appoint warrant officers in branches. The device was approved for wear in 1920; in 1921 warrant officers of the Tank Corps received the warrant officer eagle. The device later spread to all warrant officers. The device consisted of an eagle standing on a bundle of arrows, all enclosed in a wreath (figure 10). In 1926, the enlisted cap device came off, and the warrant officer's enlarged eagle device replaced the enlisted cap device.

The Mine Planter warrant officers were not required to wear the adopted warrant officer insignia. The Mine Planter warrant officers were considered "branch specific" and were authorized to continue wearing the Coast Artillery Mine Planter insignia (figure 11).

Today, all Army warrant officers are assigned to a branch. Warrant officers no longer are considered warrant officers at-large. Many people believe that all warrant officers should wear their associated branch insignia instead of the warrant officer corps insignia.

The former deputy commander, Military District of Washington, Brigadier General Evelyn P. Foote, recently speaking at a luncheon at Ft. Rucker, AL, stated:"I'm very proud of the time that I spent in the Women's Army Corps. But like many other corps, they were in and of themselves, sustaining themselves only and not contributing to the mainstream of the Army. The only way a corps, such as the Women's Army Corps, could truly and meaningfully anticipate full career participation was if we gave up something to get something."

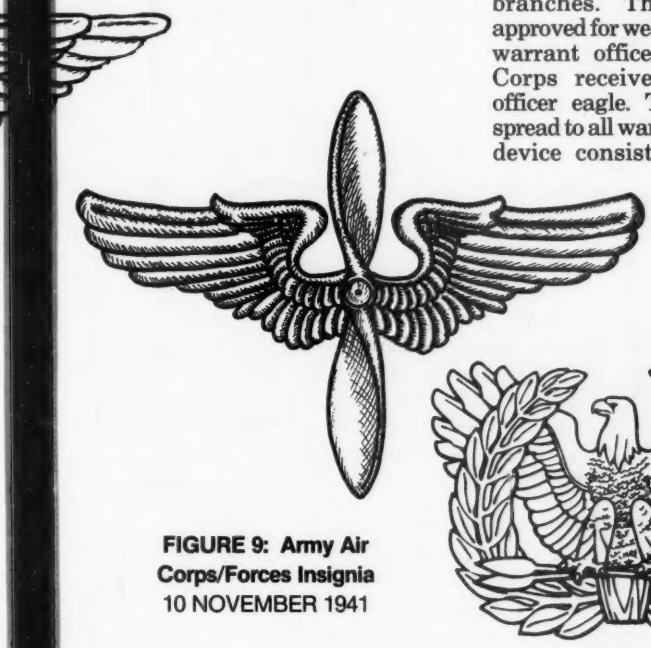


FIGURE 9: Army Air Corps/Forces Insignia
10 NOVEMBER 1941

FIGURE 10: Warrant Officer Insignia
1920

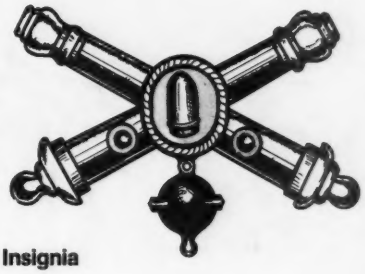


FIGURE 11: Coast Artillery Mine Planter Insignia

Want To Get Ahead ?

The following suggestions are to improve one's potential for selection for promotion, further schooling (military and civilian) and professional development.

Brigadier General
Robert S. Frix
Assistant Commandant
U.S. Army Aviation Center
Fort Rucker, AL

LOYALTY

For officers, noncommissioned officers and soldiers, loyalty is sacred and never to be violated or sacrificed. Loyalty goes three ways: down to your subordinates; laterally to your peers and contemporaries; and up to your boss and unit. Many forget loyalty to subordinates and peers to their own detriment. Most senior officers watch and judge how someone treats subordinates and peers.

INTEGRITY

Credibility is another practical word for integrity. If people don't trust your word or signature, you have a big problem. You should cherish your professional reputation, credibility and integrity. Perceptions have the same impact as reality.

DIGNITY

Part of the reason why people join the U. S. Army is to improve themselves and their self-esteem. To "step on" someone and their dignity demonstrates a lack of concern for that individual. This results in the loss of that individual's respect and support. In some cases, "stepped on" people will become your unknown enemies and will wreck your plans and reputation. Treat everyone firmly and fairly. The "Golden Rule" works. "Treat everyone as you would like to be treated." To talk ill of others in their absence undercuts your own image.

CAREER MANAGEMENT

You are your best career manager. Seek jobs with responsibility and challenge. Go see the person who controls the job. Present yourself in the best possible manner and ask for an opportunity to do the job you want. This means a lot. You may not get exactly what you want because of nonavailability of jobs or other requirements, but it won't hurt to try. More than not, it pays off. Keep your present boss informed and seek his or her advice.

CURRENT JOB

Every job is important, especially to your boss. Do your best, be positive and support your unit and boss. It's only right to support your boss; it will be appreciated; and your boss will take care of you.

RECORDS

Make sure your records are in order. Personally check them and followup on corrections made. Three key elements have significant importance in the board selection process: the official photograph; the officer record brief (ORB); and the official microfiche that includes officer evaluation reports (OERs), awards and other performance data.

The official photograph provides board members with a first impression of you. Your chances of selection are reduced if the photograph is missing, outdated, shows you as being overweight, in a poorly fitted uniform, in need of a haircut or generally is of poor quality. Ensure that your photograph represents you as a professional. Army Regulation 640-30, *Photographs for Military Personnel Files,* provides for the first officer photograph to be taken during the officer basic course. A new photograph is required every 3 years. It is also appropriate whenever the old photograph no longer represents your present appearance.

The ORB is your resume. Keep this document as current and as accurate as possible. Pay particular attention to section identification assignment history. Avoid cryptic entries, abbreviations of job descriptions and repetitive listings that may give the impression of homesteading. The annual audit, normally done during your birth month, is the primary means of updating the ORB. Your servicing military personnel office has this responsibility; however, the officer must work closely with them to ensure supporting documentation is provided. Follow the action through until completion.

Duty titles should match those indicated on the OER. Ensure that each job within the same unit is listed only once on the ORB. There should be an entry for each distinct job held, not an entry for every OER received. Frequent review is the recommended means of maintaining accurate official records. Do not wait until you are eligible for promotion to update your ORB. Your U. S. Total Army Personnel Command (PERSCOM) assignment officer or professional development officer also is available to assist you in reviewing your ORB. It is a good idea to stop by PERSCOM in Alexandria, VA, and visit personally with your career branch whenever possible. Face-to-face contact means something. You just may influence your next assignment and you can address your needs as required.

The official microfiche also must be current and complete. It should include all OERs, orders for awards and other performance data. Ensure all data pertains to you. To obtain a copy, write to: Commander, PERSCOM, ATTN: DAPC-MSR, 200 Stovall Street, Alexandria, VA 22332-0400.

Be a team member. Take care of your soldiers and your peers and they will take care of you.

AVIATION LOGISTICS
U.S. Army Aviation Logistics School

TODAY'S MAINTENANCE MANAGER/ MAINTENANCE TEST PILOT TRAINING

Captain Michael Neulander
Ms. Jane Hoppen
Department of Aviation Systems Training
U.S. Army Aviation Logistics School
Fort Eustis, VA

JUNE 1989 MARKED the 35th anniversary of formal Army aircraft maintenance officer training at Ft. Eustis, VA. In the years following 1954, the Aircraft Maintenance Officer Course (AMOC) retained the same general training philosophy and content outline. The course intent was to teach commissioned and warrant officers various subjects: aircraft maintenance management principles; aircraft maintenance tools; logistical systems and regulations; and aircraft system and subsystem operations. In 1966, "sophisticated" aircraft, such as the UH-1 Huey, necessitated additional maintenance test flight and troubleshooting training for experienced maintenance officers. This need generated the UH-1 Maintenance Test Pilot Course.

Increased aircraft sophistication and changes in maintenance test pilot qualification requirements resulted in course changes. AMOC Phase I and the eight separate tracks of AMOC Phase II were combined into a single, start-to-finish course that graduates officers prepared to maintain and test fly Army aircraft.

To fulfill this requirement, the Maintenance Manager/Maintenance Test Pilot (MM/MTP) Course was developed at the Army Aviation Logistics School at Ft. Eustis. This course, implemented in 1987, consists of a common core and a track portion. The common core portion is about 10 weeks and the track portion varies in length, generally 4 weeks, depending on the aircraft used for training in each particular track. Tracks exist for AH-1 Cobra, AH-64 Apache, CH-47B/C Chinook, CH-47D Chinook, OH-58A/C Kiowa, OH-58D Kiowa, UH-1 and UH-60 Black Hawk aircraft. The MM/MTP Course's common core is designed to prepare commissioned officers and warrant officers for all aspects of managing and performing as maintenance test pilots. The major topics of the common core entail management, logistics and aeronautical technology (commonly referred to as systems). The track portion provides flight and

academic instruction in maintenance test flight procedures, aircraft systems' operations and maintenance troubleshooting.

The management portion of the MM/MTP Course covers many aviation subjects. Following is a breakdown of the primary blocks of instruction and the topics covered in those blocks:

- Aviation maintenance structure.
  - Three-level aircraft maintenance structure.
  - Aircraft maintenance force structure, to include how tables of organization and equipment and modified tables of organization and equipment (MTOEs) are developed.
  - Reading and interpretation of aviation intermediate maintenance (AVIM) MTOEs to determine authorizations.
  - Duties and functions of aviation classification repair activity depots.

- Duties, operations and responsibilities of maintenance organizations.
  - Operation of typical maintenance sections.
  - Production control (PC) in maintenance sections.
  - Quality control (QC) in maintenance sections.
  - How PC and QC function together effectively.
  - Differences between the PC and QC shops operating in aviation unit maintenance (AVUM), AVIM and depot.

- Aviation maintenance work requirements.
  - Army maintenance system.
  - Inspection system.
  - Scheduling of aircraft for missions and maintenance, using flow charts, daily status reports and bank time.
  - Details of maintenance operational checks and maintenance test flights and the Army regulations governing them.

- Logistics assistance and maintenance assistance instruction teams, to include determining needed assistance and where to find it.

- Reports and estimates.
  - Status reporting, including Department of the Army (DA) Form 1352, Army Aircraft Inventory, Status and Flying Time, and DA Form 3266, Missile Equipment Failure Report.
  - Manpower accountability, including using statistics to maintain and manage aviation work force and establishing capabilities, limitations, requirements and productivity.

- Safety.
  - Maintenance officer's role in accident investigations.
  - Estimated costs of damage (determination of repairs needed, man-hours needed for the repairs and level of maintenance required.

- Aircraft forms and records.
  - Aircraft logbook.
  - Historical records.
  - Maintenance inspection checklists.

- Aircraft maintenance training exercise.

The management portion of the MM/MTP Course includes the three aircraft maintenance practical exercises: an 8-hour aircraft phase exercise; a 10-hour major component replacement exercise; and a 14-hour aircraft transfer exercise. All three practical exercises task the students to use sound logistical and managerial principles. Throughout the exercise, the students role play the positions of all AVUM personnel and the instructors role play the positions of all AVIM personnel. Students receive fictitious records and all material needed to prepare aircraft paperwork.

The logistics portion of the MM/MTP Course includes the following main topics:

- Relief from responsibility—discusses the regulations and actions necessary for accountability, to include subhand receipts and reports of survey.
- Requisition and issue of supplies—provides an overview of Army Regulation 725-50, *Requisitioning, Receipt and Issue System.*
- Operational readiness float (ORF)—covers ORF operations in the field and discusses ways to gain support and to borrow from ORF should an aircraft be disabled.
- Aviation maintenance publications—provides an overview of all 23P-series technical manuals (TMs).
- Supply publications—deals strictly with the use of microfiche and computers (Army Master Data File and the Master Cross Reference List).

- Identification Lists and Commercial and Government Entity Code Handbook H4/H8.
- Repair parts supply procedures—covers managing the prescribed load list (PLL).
- Direct support unit (DSU) procedures—covers managing, requesting and issuing supplies in the authorized stockage level (ASL).
- Logistics performance indicators—discusses indicators needed to better manage PLL.
- Automated field stock control procedures, DSU—gives an overview of unit- and DSU-level automated systems.
- Army intensive managed items—Tracking Army Serial Numbers-Aircraft—describes procedures for requesting and controlling components.
- Forecast and brief the commander—gives students indicators needed to provide the commander with a better understanding of aviation maintenance policies and procedures concerning the activity.
- Tactical Army Computer Command Systems (TACCS)—provides briefing on TACCS' capabilities at unit level.
- Defense Reutilization Management Office supply procedures and reutilization tour—shows students all disposed and reissued property for use at the unit level to meet the unit's mission requirements.
- Logistics training exercise.

The scenario-driven, 4-day practical exercise for logistics envelopes all blocks of instruction into a hands-on training exercise. Throughout the exercise, students work through all levels of supply in the Class IX arena. Students begin at the unit-level PLL section with actual requests for repair parts. The requests eventually go through fellow students at various stations, concluding with the issue of the part. This procedure enables students to see the actual problems that occur in the field. This also ties together all of the training received to that point. The stations in the exercise include:

- PLL section at unit level.
- ASL at the support level.
- National inventory control point.
- Depot.
- Command Logistics Assistance Team (CLAT)—CLAT does a complete command inspection with assistance visits to all areas and then briefs fellow students on discrepancies and solutions. Each student will perform at each individual station for a given period.

The aeronautical technology portion of this course provides students a generic, general overview of all aircraft systems and how they function with each other. For example, the block of instruction on the electrical systems covers basic electricity in general, such as wiring diagrams and components. Also the hands-on exercise includes troubleshooting and using electrical analytical equipment. The specifics for each aircraft are more thoroughly discussed in each individual track during the test flight phase of the course. Reference publications are not covered in detail, but students are taught what publications they need, such as TM 1-1500-328-25, *Aeronautical Equipment Maintenance Management Policies and Procedures,* to perform effectively and to locate answers to various maintenance questions. Aeronautical technology offers general overviews on the following subjects:

- Aviation shop and maintenance safety.
- Avionics.
- Fuel systems.
- Weight and balance.
- Aircraft storage and recovery.
- Nondestructive inspection.
- Airframe maintenance.
- Introduction to electrical components and devices.
- Rotor systems.
- Introduction to pneudraulics.
- Flight controls.
- Test, measurement and diagnostic equipment.
- Powertrains.
- Aircraft survival equipment.
- Threat forces (see *U.S. Army Aviation Digest,* September 1988).
- Ground support equipment.
- Aviation maintenance operations in combat.
- Aviation maintenance in unusual environments.

The track portion of the MM/MTP Course is the aircraft-specific portion. In the track, students receive flight and academic instruction in conducting general and limited maintenance test flights on their respective aircraft. Flight training periods prepare the students to conduct test flights in accordance with Field Manual 1-544, *Standardized*

Maintenance Test Flight Procedures. Daily flight training periods include conducting a complete general test flight. Instructors introduce system faults daily. This reinforces academic instruction in the systems' operations and aids students in developing fault analyses (troubleshooting) skills.

Students learn aircraft-specific subjects during the track portion's academic training and daily actual test flights.

- Maintenance readiness inspections.
- Maintenance test flight forms and regulations.
- Electrical and warning systems.
- Fuel systems.
- Powerplant operation.
- Powertrain systems.
- Pneudraulic systems.
- Turbine engine analysis.
- Vibration analysis.
- Flight controls.
- Utility systems.

Students log about 12 hours of flight time on their respective aircraft during the track portion of MM/MTP.

The MM/MTP Course is a comprehensive course that prepares officers for a variety of duties in aviation maintenance organizations. Commanders interested in providing candidates to attend the course should refer to DA Pamphlet 351-4, *Army Formal Schools Catalog.* This reference includes course prerequisites and lists the records and equipment students must bring with them to Ft. Eustis.

The graduates of this course are valuable assets to aviation commanders. Graduates need to sustain perishable skills and knowledge acquired during the course. Therefore, they should be programed for utilization assignments as aircraft maintenance officers after completion of the course. All graduates of the course are awarded the 15D designation.

U.S. Army Class A Aviation Flight Mishaps

	Number	Flying Hours	Rate	Army Fatalities	Total Cost (in millions)
FY 88 (through 30 Sep)	32	1,741,997	1.84	39	$59.0
FY 89 (through 30 Sep)	35	1,673,943*	2.09*	35	$100.9

*estimated

AIRCRAFT COMPONENT MANAGEMENT

Colonel Gary D. Johnson
Director of Maintenance
U.S. Army Aviation Systems Command
St. Louis, MO

HOW TO GET in trouble in a hurry. Your bird is on the ground and the boss needs to fly an important mission tomorrow. The stability augmentation system actuator you need came in this morning without proper records and you do not know whether you should use it or not. Sound familiar? Well, you are not alone in your dilemma—you have lots of company. Help is available that you may not be fully aware of—so read on!

Most maintainers of Army aircraft are intimately familiar with the DA Form 2410 or the AMSAV-M Form 2410 Test, Component Removal, Repair/Overhaul and Installation Record, which is used exclusively on the AH-64 Apache helicopter. You know about it because you have filled out so many of them. What you may not know much about, however, is what happens to it and 2410 data after you send it to the U.S. Army Aviation Systems Command, St. Louis, MO, better known as AVSCOM. The following information should give you a better understanding of and appreciation for the 2410 and how it is used after you complete it:

- First, a short refresher on what the 2410 is all about. It is an element of the aircraft component tracking system under the Army Maintenance Management System-Aviation or TAMMS-A. A critical need exists for many of the dynamic components used on helicopters, thus the need for time management and tracking of these items during their life cycle. The 2410 provides a method for tracking these "time change" parts, components and assemblies when the item *is not* installed on an aircraft. When the item is installed, other aircraft logbook records come into play, thereby completing the tracking cycle. This documentation, as a minimum, includes: item identification; how many hours are on the item since it was new; when it was last installed, or overhauled; and its last reported serviceability status.

• Second, after AVSCOM receives the 2410, data from the form are entered into a computerized data base. The size of this data base is apparent from the following figures:

2,624,000 individual 2410 records
in the current working data base.
10,000,000 plus 2410 records in total
2410 data base dating back to the late 1960s.
35,000 to 45,000 2410s received at
AVSCOM monthly.

• Engineering and maintenance trend analysis of 2410 data may detect or support other indications that an item is not attaining established hours of operation. Failure code trends also can be studied to evaluate possible reasons for premature failure. These trends can support a decision to lower the number of hours an item may be operated before it must be removed for overhaul or retirement. On the other hand, these trends may support a decision to increase allowable operating hours for the items. Such a decision, whichever way it goes, will have obvious safety, supply and fleet readiness implications.

• In many cases, the physical location of an item can be determined quickly should the item be affected by an urgent safety action.

• Historical data on a component can be reconstructed, a majority of the time, from 2410 information on record. When minimum data for a particular item are on record, operational time on the item can be calculated, using a formula that has a built-in, liberal safety factor.

• A 2410 Hotline is operated in the Directorate for Maintenance at AVSCOM. You may call to obtain component information or component data reconstruction—*in a hurry.* (See Hotline information on next page.)

Measurable Benefits

Besides those above, the Army is realizing other significant benefits because of the existence of the AVSCOM 2410 data base. Foremost is measurable cost avoidance realized by the prevention of premature scrappage and early overhaul of expensive components. This cost avoidance occurs when the user (soldier) or other authorized facility contacts the AVSCOM 2410 Hotline on a component data problem. The 2410 data base is used to construct actual and current information status on the item. When necessary, the search will go to the last overhaul facility or back to the original manufacturer. When limited, but certain, 2410 data are available, current operating hours and status of the item are calculated. This data reconstruction may allow continued use of the item and, thus, premature scrappage or overhaul of the item may be prevented. If so, a cost avoidance results. In this case, cost avoidance is a portion of the cost that would be necessary to replace or overhaul the item. For example, during fiscal year (FY) 1988 we experienced:

927 requests for component data each month
$29,000,000 cost avoidance—FY 1988

The AVSCOM 2410 Hotline is for Everyone

The 2410 Hotline, here in the Directorate for Maintenance at AVSCOM, was set up expressly to support and help you (see page 44). We encourage you to use it whenever you have a questionable component and you are tempted to scrap or return the component to maintenance channels as unserviceable. This goes, too, for installed items when, for example, the serial number on the item does not match the logbook records. Let us check it out, and you may be spared aircraft downtime waiting for a replacement from supply. In the meantime, keep the 2410s moving with the thought that your effort is eventually going to help someone else and also benefit the Army.

Recently, AVSCOM produced an interesting video tape on the 2410 story. Not a "how to fill it out, block-by-block" tape, but one that presents the 2410 in proper perspective. The video tape

comes in video home system and three-fourth inch U-matic format. You should be able to obtain the tape for viewing by contacting your local AVSCOM logistics assistance representative. This tape is intended to increase the awareness of your people involved with 2410s and their importance to you, your aircraft and to the Army.

Apache Test Forms

The Directorate for Maintenance, AVSCOM, is the only source for AMSAV-M Form 2410 Test, which is used exclusively on the AH-64 helicopter. Use the 2410 Hotline if you need a supply of these forms or make your publications people aware of this source of supply.

THE HOTLINE CONNECTION

You can contact the AVSCOM 2410 Hotlines by one of the following methods:

CONTINENTAL UNITED STATES

Write to - Commander
U. S. Army Aviation Systems Command
ATTN: AMSAV-MMD (2410)
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

Telephone - Mr. Marlin Wade or Mr. Elwood Miller
AUTOVON 693-1879
Commercial 314-263-1878

Datafax - AUTOVON 693-2075
Commercial 314-263-2075

E-mail - data2410@avscom.arpa

For 2410 questions dealing *only* with items repaired or overhauled by Corpus Christi Army Depot, TX

Telephone - Mr. Gary Hilliard or Mr. Fred Barcroft
AUTOVON 861-3990

Datafax - AUTOVON 861-7376
Commercial 512-937-7376

KOREA

Write to - Mr. Charles Carder or Mr. Jim Floyd
ATTN: LAO-FE (AVSCOM)
APO San Francisco 96301-0066

Telephone - Commercial 82-279-146229

Datafax - Commercial 82-279-148411

E-mail - amsavlak@avscom

U. S. ARMY, EUROPE

Coleman Barracks - Mr. Frank McGhee or Mr. Tom Greer

Write to - AVSCOM (DynCorp), Data Reconstruction-Europe
ATTN: J. F. McGhee
B Company, 70th Transportation Battalion
APO New York 09028

Telephone - AUTOVON (ETS) 382-5109/5390
Commercial 0621-779-5109/5390 or
0621-788539 (0700-1300 hours CET)

Datafax - Commercial 0621-788539

E-mail - amxeu-1-avscom-laen040seckenheim-EMH1.army.mil

Frankfurt (V Corps) - Mr. Keith Bouteiller

Telephone - AUTOVON (ETS) 320-5304/7746
Commercial 069-151-5304/7746

Datafax - Commercial 069-151-7746

E-mail - amxeu-1-avscom-laen@seckenheim-EMH1.army.mil

Nellingen (VII Corps) - Mr. Doyle Archie

Telephone - AUTOVON (ETS) 421-6652
Commercial 0711-3488-652

Datafax - Commercial 0711-3488-644

E-mail - amxeu-1-avscom-laes@seckenheim-EMH1.army.mil

PEARL'S

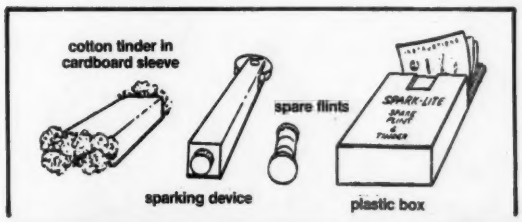
Personal Equipment And Rescue/survival Lowdown

Survival Water Packets

These water packets, NSN 8960-01-124-4543, will be fielded soon. The nomenclature, Water, Drinking, Emergency, Flexibly Packaged, MIL-W-44126, contains 4 ounces of water. The packets, sealed on four sides, replaces the canned emergency drinking water: two packets replace one can, but five packets replace two cans. The canned water comes in 10-ounce quantities. The Natick Research Development and Engineering Center, Natick, MA, authorized the substitution. The source of supply is S9S, the unit of issue is BG (bag), and the quantity box has 24 bags. The U.S. Army Aviation Systems Command will enter this information into the Army Master Data File (AMDF).

Fire Starters

The Fire Starter, Aviation Survival, Spark Lite, NSN 1680-01-233-0061, should be in the supply system by October. The NSN has been in the AMDF for the past 2 years, but not procurable until now. The spark lite, a simple fire starting device, has necessary items in a plastic box: a sparking device, several waterproof cotton tinders, extra flints and instructions how to use the contents and make a basic fire. Users should not confuse this fire starter with the Fire Starter, Aviation Survival, Magnesium. However, soldiers can use either starter in any survival kit except the overwater survival kit. The more fire-making tools available, the better the chances of signaling with fire or smoke, building a fire to cook or heating the body when chilled. The Army has no mandatory survival school for aircrewmembers before they leave flight school or advanced individual training. However, until such time when the U.S. Army Training and Doctrine Command begins formal survival schooling for aircrewmembers, individuals should read Field Manual 21-76, *Survival*, and practice survival techniques including fire making.



Microphone Bracket for MBU-12/P Oxygen Mask

Users can requisition the M-169/AIC Microphone Bracket (NSN 5965-01-233-0771) from the Defense Electronic Supply Center for $25.52. Besides improving performance, this microphone/bracket is more adjustable and reliable than the M-100 Microphone/Bracket.

If you have a question about personal equipment or rescue/survival gear, write PEARL'S, AMC Product Management Office, ATTN: AMCPM-ALSE, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798 or call AUTOVON 693-3573 or Commercial 314-263-3573.

Captain John B. Rudi
Directorate of Combat Developments
U.S. Army Aviation Center
Fort Rucker, AL

NEW

photographs by Myra Harris

HELMET

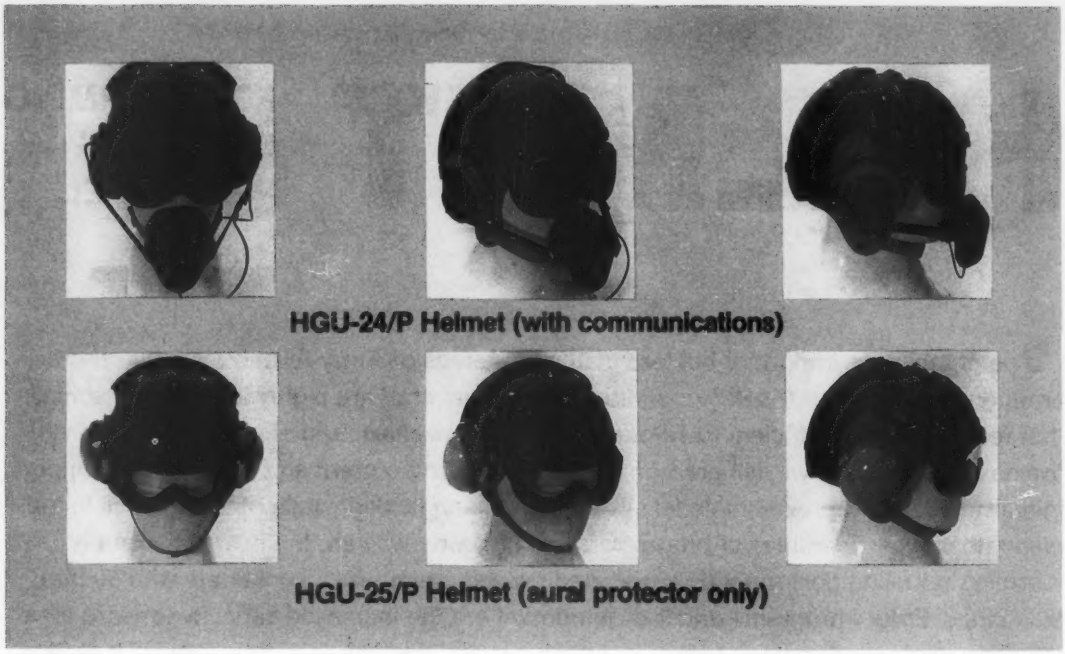
FOR REARMING REFUELING PERSONNEL

One of the more important but less glamorous areas of Army Aviation is forward arming refueling point (FARP) operations. Today's aircraft are highly advanced machines that require fast and efficient FARP support to achieve maximum effectiveness. During the next few months, we will present articles addressing current and future FARP support initiatives. Some improved materiel systems are being fielded, while others are still in the planning stages. Examples of programs currently underway are the helmet assembly rearming refueling personnel (HARRP) and revised ammunition containers with 30 mm bulk strips. Future programs under development are the increased capacity forward area refueling equipment system; rocket fast pack system; and field-capable, ground-handling vehicles. These programs are designed to economically increase FARP efficiency and maintainability. Top grade aircraft require top grade support. That is why the U.S. Army Aviation Center, U.S. Army Ordnance School, U.S. Army Quartermaster School and the U.S. Army Aviation Logistics School are determined to bring the best support possible to Army Aviation.

BEGINNING 1 OCTOBER 1989, a new helmet for rearming and refueling personnel is available through the Army supply system. The HARRP, or helmet assembly rearming refueling personnel, is a cost-effective adaptation of the flight deck helmet currently used by the Navy. Introduction of the HARRP replaces the need for the heavier and more expensive SPH-4 flight helmet. Two versions of the HARRP are available for issue: the HGU-24/P (communications equipped) and HGU-25/P (aural protector only). Both types consist of four components: a cloth inner helmet, front and back impact shields, front and back foam pads and a microphone/headset assembly (HGU-24/P) or aural protector (HGU-25/P). Sun, wind and dust goggles furnish eye protection.

The HARRP provides cranial protection at half the weight, and considerably less cost than the current sound protective helmet number 4 flight helmet. The HARRP is designed to protect the user from moderate impact and high-intensity noise only, and should be marked accordingly (nonballistic item). This helmet should not be issued for flight crew or passenger use.

During soldier test and evaluation analysis, the HARRP was received favorably. Some problems were encountered when using the HARRP with the M-17 and M-24 protective mask hood. However, all tested personnel were able to wear the M-17 and M-24 protective mask without degrading the mask's seal. The HARRP is also PVS-5 compatible when used with the GX5 flip-up mount. The HGU-24/P communication jack is compatible with



HGU-24/P Helmet (with communications)

HGU-25/P Helmet (aural protector only)

internal and external aircraft communication connectors.

The HARRP is authorized for all aviation units at one per soldier for military occupational specialties (MOSs) 68J, 55B and 77F. The HGU-24/P (communications equipped) is designed for use by petroleum supply specialists (77F) and aircraft armament/missile systems repairers (68J), while the HGU-25/P (aural protector) is to be used by ammunition specialists (55B). Because of limited supply density, units should restrict requisitions to one HARRP (HGU-24/P or HGU-25/P) per authorized table of organization and equipment position for the MOSs listed above. The helmet assembly is not available as a unit, but is assembled by ordering the parts listed at right through the Army supply system. (Authorization for the HARRP is CTA 50900.)

The HARRP system is another example of using present technology to accomplish our mission better while reducing cost. The idea for introduction of the HARRP is credited to Captain Donald Dunkerson. Above the Best!

item/national stock number	source of supply	unit price FY 1989
Helmet, cloth, MIL-H-81735:		
Size 6 3/4: 8415-00-861-3527	S9T	$8.95
Size 7: 8415-00-071-8785	S9T	8.95
Size 7 1/4: 8415-00-071-8786	S9T	8.95
Size 7 1/2: 8415-00-071-8787	S9T	8.95
Back Pad: 8415-00-178-6830	S9T	3.95
Front Pad: 8415-00-178-6831	S9T	2.95
Shield, Flight Deck, Back Brown: 8415-00-178-6855	S9T	2.55
Shield, Flight Deck, Front Brown: 8415-00-178-7013	S9T	2.55
Headset-Microphone Kit (Aural Component for HGU-24/P): 5965-01-204-8505	S9E	91.88
Aural Protector (For HGU-25/P): 4240-00-759-3290	S9G	8.45
Sun, Wind and Dust Goggles: 8465-01-004-2893	S9T	3.85

CURSE ALL THESE REGULATIONS!

Major Peter Neuhaus
Australian Exchange Officer
Directorate of Evaluation and Standardization
U.S. Army Aviation Center
Fort Rucker, AL

ONLY A FEW aviators would argue that the quantity of regulatory documents that guide Army flying has flourished in recent years. Most of us have heard aviators say these regulations would go out the window in times of conflict. Well, I hope not!

Most of us would like to see simpler consolidated regulations typified by the new AR 95 series. However, only a few of us would feel comfortable with the arbitrary removal of any of our present regulations. The aviator's environment is not created by regulations, but rather regulations are responsive to the environment. So the authorities' intent is to direct my flying to suit the environment in which I operate. A lot of experience is out there and a lot of costly lessons have been learned. Regulations take advantage of this experience. Let's look at a couple of areas where the regulatory aspects are poorly understood.

Directorate of Evaluation and Standardization (DES) visits reveal that units work hard to get their unit standing operating procedures (SOPs) in line with all regulations and published guidelines. However, what is disconcerting is unit personnel generally do not know their SOPs' contents. Perhaps we should reflect on the purpose of an SOP. An SOP–

- Establishes exactly how the unit will achieve its mission.
- Outlines proven techniques and methods that help achieve the unit's mission and tasks.
- Shows how the commander influences unit personnel to perform their tasks. This is one of the most significant ways commanders can place their personal stamp on the unit.

For an SOP to achieve its purpose, it must be concise, unambiguous and used regularly by unit aviators. The better SOPs I have seen are those that crewmembers carry as spin-off, pocketbook size supplements. SOPs should serve as living documents and ready references to answer "how" questions.

Another poorly understood area is the aircrew mission briefing. DES evaluations indicate that while most aircrews comply with the regulatory aspects, many units have forgotten the purpose of a briefing sheet.

How did it evolve? A number of past accidents list command and supervisory errors as contributing causes. As a result, the briefing sheet was developed to assist the commander and ensure the involvement of the chain of command. The aircrew mission briefing gives required key elements for completing the mission.

Aircrew missions have three parts. The first part is the briefing officer's *detailed instructions.* The second part is the *brief back*—the pilot in command (PC) or airmission commander (AMC) briefs back the key elements of the mission and informs the briefing officer they can accomplish the mission. The third part is the *post mission debrief*—the PC or AMC debriefs the briefing officer on how they performed the mission; deviations from the initial briefing; and the aircraft/aircrew status.

Field Manual (FM) 1-300, *Flight Operations and Airfield Management,* leaves the content and format entirely up to the user, provided the briefing includes mandatory items listed in this FM.

Curse the regulations? No! They provide us with useful tools to assist and protect us in this demanding environment. While regulations are far from perfect, remember their intent is to help rather than hinder.

Heaven forbid if all the experience and good ideas in regulations go out the window when the first shot is fired. If that happens, I would rather stay on the ground—not for fear of foe, but of friends.

DES welcomes your inquiries and requests to focus attention on an area of major importance. Write to us at: Commander, U.S. Army Aviation Center, ATTN: ATZQ-ES, Fort Rucker, AL 36362-5208; or call us at AUTOVON 558-3504 or Commercial 205-255-3504. After duty hours call Fort Rucker Hotline, AUTOVON 558-6487 or Commercial 205-255-6487 and leave a message.

AIR TRAFFIC CONTROLLERS: Airborne All The Way

Lieutenant M. Scott Andrews
Staff Sergeant Roger D. Martin
B Company
1-58th Aviation Regiment
Fort Bragg, NC

Time: 0350

The team is cross-loaded in the second of a flight of seven Air Force C-130 Hercules aircraft. Jumpmasters have given the 20-minute warning and moved the 300-pound door bundles to the door. Their uncomfortable 70-minute flight is almost over and the adrenalin begins to flow in anticipation. . . .

Time: 0410

"Time on Target." Everyone's eyes are on the jumpmaster and even the most experienced jumpers' bodies tingle with excitement. "Jumpers stand in the door: green light—go, go, go. . ." As the team exits the aircraft from 800 feet, the members are buffeted by the prop blast and given a brief respite from their heavy load. The moonlit sky is dotted with olive-drab parachutes. During the drop, the team parachutes near the bundles so the soldiers can land closer to their bundles. Upon reaching the ground, the team assembles and begins moving the portable air traffic control (ATC) tower to a more tactical position for ATC. The weight of the TSQ-97 and the 90-pound packs is almost unbearable, but the urgency of the mission keeps them going.

Time: 0456

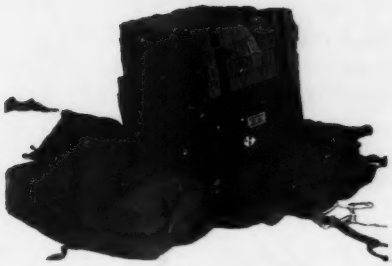
A green star cluster arcs lazily upward, brightening the predawn sky and indicating the infantry has secured the airfield. Radios come alive; choppers are inbound from the north at 5 miles. Army air traffic controllers on the ground talk to Army aircraft. The team and its equipment have been delivered by parachute to the objective airfield.

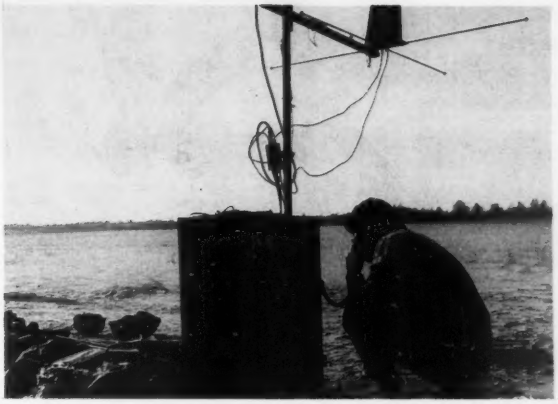
The lst Platoon (Airborne) is part of B Company, lst Battalion, 58th Aviation Regiment. Its mission is to support the 82d Airborne Division with air traffic services. The platoon is task-organized into three 10-man ATC support teams and maintains one team on a 2-hour recall status around-the-clock for rapid deployment. Each team consists of a four-man tactical tower section (TAC team), a four-man beacon section and two liaison officers (LOs).

The TAC team works primarily with the AN/TSQ-97—a portable, air droppable "minitower." The AN/TSQ-97 is an avionics system with FM, VHF and UHF radios. Broken down into its carrying configuration, it weighs about 200 pounds as a four-man lift. The primary mission of the TAC team is to control the Army aircraft in the airhead and to act as a flight operations center. The team advises all aircraft of the Army airspace command and control (A2C2) measures in effect and ensures that aircrews know all local flight hazards. Other missions include establishing communication with the aviation liaison in the assault command post and controlling the beacon section.

The beacon section's primary mission is to establish and maintain an AN/TRN-30(V1) beacon near the airfield. The beacon assists the aviation task force follow-on in locating the landing zone. The beacon is a one-person portable, low-powered beacon that emits a signal to help navigate aircraft. The beacon itself weighs about 45 pounds. Accessories and batteries add 80 pounds among the section members. The section also carries a PRC-77 to maintain communication with the TAC team and LOs.

The LO section usually is located in the assault command post and consists of an officer and a noncommissioned officer who carry a secure PRC-77. They help with the following missions: developing the A2C2 plans; passing the A2C2 measures and other coordinating information of the TAC team; and maintaining control of the ATC support team.





The AN/TSQ-97 air drops to the objective airfield; the protective packing prevents the equipment from damage; and finally, a member of the tactical tower section gives weather information and landing instructions to the aircraft.

The ATC support team, as a unit, serves as the advance party for the rest of the platoon. The team can provide the supported unit a controlled airfield, landing zone, or a forward arming and refueling point. If the airhead expands, the platoon is equipped to provide an airfield follow-on. Also, the platoon can establish a fully instrument flight rules-capable airfield and instrument route structure for the division.

Because of its variety of missions and the need to be self-sufficient for 72 hours, the team has an enormous amount of equipment to carry with it on every operation. Thus, team members carry few "creature comfort" items. A typical pack carries a PRC-77 with secure gear, extra batteries, VS-17 panels, SE-11 light gun and binoculars. Personal items consist of one battle dress uniform, one poncho and its liner, four pairs of socks, one towel, shaving gear, and 3-days worth of meals ready-to-eat and water. Add these necessities: T-10 B/C parachute and reserve; load bearing equipment; and M-16 and M/1950 weapons container. Now the airborne controller leaves the aircraft with almost 150 pounds strapped to his body.

Aside from ATC support, 1st Platoon has another mission to prepare. Because of the nature of tactical ATC, the platoon has to lead the elements of the assault force. As a result, the 1st Platoon personnel must prepare to fight like infantrymen on the airfield to help secure it while they perform its ATC mission.

Consequently, being an airborne tactical air traffic controller requires a special kind of soldier. It requires an individual who has the aggressive "all-the-way" attitude of a paratrooper, while at the same time can remain absolutely calm under the pressure of controlling Army aircraft.

The 1st Platoon (Airborne), B Company, 58th Aviation Battalion (ATC), was organized in October 1979. It was later activated as part of the 58th Aviation Regiment in 1986, but has been on jump status for 10 years. On 8 September 1987, the platoon organized the battalion's first *self-supported* airborne operation from a C-130. Today, the 1st Platoon (Airborne), more proud than ever, continues its tradition of providing outstanding ATC support to the 82d Airborne Division. It remains the only airborne ATC unit in the U.S. Army.

Readers are encouraged to address matters concerning air traffic control to Commander, USAAVNC, ATTN: ATZQ-ATC-MO, Fort Rucker, AL 36362-5265.

Captain Paul M. Steele
Davison Aviation Command
Military District of Washington

TRAINING

"Foolish or even criminal is the word to describe the behavior of an Army that does not prepare itself to master all the various types of weapon, and all means and methods of waging combat, that the enemy has or might have."

V.I. Lenin

THREAT TRAINING is often looked upon as being boring, redundant, too difficult and unnecessary. But there are those of us who enjoy threat knowledge so much that it has become our hobby. Others study threat because they have been tasked to train others. These are the individuals that this article is intended to assist—to help threat trainers increase their own threat knowledge and improve their teaching techniques.

The term "threat training" is used throughout this article to describe the field of study that includes threat and friendly forces doctrine, tactics and equipment as well as methods of instruction.

Why Threat Training?

The most important reason for threat training is combat survival. By knowing the capabilities, limitations and employment of threat weapons, aviators and commanders alike can exploit weaknesses and avoid defeat.

The avoidance of fratricide is the reason for threat training most recognized by soldiers. It's not hard to imagine the terror of accidentally destroying a friendly target. This has led to simple "friend or foe" identification training. (The pitfalls of this type of training will be discussed later.) For too many, however, friend or foe is reduced to, "If it shoots at me, I'm going to shoot back." Although no one would argue with self-defense, why wait for a possible target to shoot first? Quick and accurate identification is the key to survival and the avoidance of fratricide.

Accurate and useful intelligence information is the final reason for threat training. Accurate spot reports of vehicle and weapon types and quantities can enable intelligence personnel to identify types, strengths and even designations of enemy units. In turn, this information can be used by command-

THE THREAT TRAINER

ers to employ their assets where and when they are most effective against the enemy.

Training the Trainer

Although there are several good threat training courses, such as those offered by the 7th Army Training Command at Grafenwoehr, Germany, many threat trainers must teach themselves. Furthermore, all threat trainers must stay current on the most up-to-date information. The most effective way to do both is to form a personalized self-study program. A self-study program allows threat trainers to train themselves in a concise and progressive manner, thereby avoiding disjointed and unguided study that can result in frustration and "gaps" in knowledge. Furthermore, many of the techniques and hazards described also can apply to training others.

Self-Study

Any self-study program begins with a determination of your present level of knowledge. To some this will be obvious, while others will have to test themselves. Try to identify a dozen or so threat and friendly aircraft and ground vehicles from photographs with their captions covered. Try to find photos from sources you have not seen before. If you can identify them with accuracy, try reciting the armament types and ranges of the vehicle-mounted weapons. Subjectively evaluate your results and place yourself within one of the three levels of study described below.

Level 1: Emphasis is on positive identification of ground vehicles and aircraft only.

Level 2: Emphasis is on threat capabilities and limitations. Constant review and update of Level 1 material is essential.

Level 3: Emphasis is on employment doctrine, tactics and foreign use. Review and update of Level 1 and 2 material must be continued.

The next step is to establish the goal of your training program. Although it would be optimal for everybody to be an expert in all aspects of threat, no one has the time or resources available to achieve that level. It is more valuable if every aviator could become an expert at vehicle recognition and capabilities while the air battle captains must include tactical doctrine into their self-study. Threat training officers and G2/S2 intelligence personnel, of course, will be concerned with all aspects of the three training levels.

Now that you've established where you are and your goals, the next step is to begin gathering study materials. The basic materials necessary for threat training self-study are photographs and books. Although the Army produces many threat training publications, they tend to overuse the same photos, lack color, and are not updated as frequently as necessary. Many civilian bookstores carry oversized books with many color photos and drawings as well as useful and interesting information. These books tend to be very subject specific (e.g., "North Atlantic Treaty Organization (NATO) tanks" or "Warsaw Pact Aircraft"). News magazines as well as defense industry oriented periodicals are an excellent source of information and photographs of current and even future weapons.

The key to effective vehicle identification study is to gather as many different photos of different views of each vehicle as possible. The key to studying capabilities, limitations, tactical employment and foreign usage is to screen your sources carefully for the most accurate and current information. Review authors' credentials and sources, and depend on reputable publishers and publications such as *Jane's* and *Aviation Week*

Soviet Helicopters: Design, Development and Tactics, John Everett-Heath (London: Jane's Publishing, 1988).

Jane's AFV Recognition Handbook, Christopher F. Foss (London: Jane's Publishing, 1987).

Jane's World Aircraft Recognition Handbook, Derek Wood (London: Jane's Publishing, 1987).

Soviet Military Power, Secretary of Defense, Ed. (Department of Defense, published each spring since 1981).

Soviet AirLand Battle Tactics, William P. Baxter (Novato, CA: Presidio Press, 1986).

Weapons and Tactics of the Soviet Army, David C. Isby (London: Jane's Publishing, 1988).

The Encyclopedia of World Air Power, Bill Gunston, Ed. (New York: Crescent Books, 1981).

Modern Land Combat, David Miller and Christopher F. Foss (New York: Crown Publishers, 1987).

Modern Weapons, Ray Bonds, Ed. (New York: Crescent Books, 1985).

Jane's Defence Weekly, Jane's Publishing (a weekly periodical).

Aviation Week and Space Technology, McGraw-Hill Publications (a weekly periodical).

FM 44-30, *Visual Aircraft Recognition.*

FM 1-402, *Aviator's Recognition Manual.*

FM 100-2-3, *The Soviet Army Troops Organization and Equipment, 1984* (revision is due out in 1989).

THREAT

BOOKS

and Space Technology. However, be sure always to cite your sources during threat instruction. Some of the most useful publications are listed above.

Identification Study Tips

Constant exposure is the cornerstone of effective vehicle identification study. The same individuals who claim that identification training is too difficult can probably tell, at a glance, the difference between the same year Chevrolet Camaro and Pontiac Firebird, even though those two autos probably look more alike than any two military vehicles around today. The reason is because they see those vehicles almost every day. However, most of the vehicles and aircraft we see are not around us every day, if ever. Therefore, you must make an effort to bring the vehicles and aircraft to you. Hang pictures and posters up around your work or study area. When you see a vehicle on the news or in a magazine, try to identify it. If you can't, remember its features and look it up later. You will be amazed by how much you learn just by making the effort.

One of the more difficult aspects of identification study is nomenclature. Who wouldn't be confused by names like BTR, BRDM, BMP, BMD, ACRV, Fitter, Flanker, Hind, Hip, etc.? It is difficult to memorize an unfamiliar and unusual name and associate it with an equally unfamiliar vehicle. It becomes easier, however, when the origins and reasons behind the names become clear. Field Manual (FM) 44-30, *Visual Aircraft Recognitions* and FM 1-402, *Aviator's Recognition Manual,* provide good definitions and origins of NATO aircraft designations and NATO names of Soviet equipment.

Identifying vehicles becomes further simplified when you learn about their parts. Knowing what

TRAINING SELF-STUDY MATERIALS:

PERIODICALS

SCALE MODELS

PHOTOGRAPHS

a coincidence rangefinder is, and how it works, helps clarify what it looks like, where it is located, and how a tank with one would differ from a tank with a laser rangefinder. This principle applies to everything from canards, dorsal spines and ventral fins, to thermal shrouds, mantlets and return rollers.

Building scale models is probably the best way of learning to identify any vehicle. Apart from being around the real thing, models will be your only opportunity to touch and examine every part of the vehicle, even if only in miniature. By holding, examining and assembling the parts, you gain a sense of proportion and orientation for how they relate to the entire vehicle. Furthermore, you have the opportunity to view the vehicle from every angle. Model building makes identification study active instead of passive. After completion, the models can be used as training aids for threat classes. They do not have to be museum quality to aid in identification study, only "recognizable."

Identification Study Pitfalls

Learning to identify vehicles as either friend or foe is ineffective. Friend-or-foe training does not take into consideration foreign weapons sales and fluid global politics. U.S. built F-4 Phantoms, F-14 Tomcats and AH-1 Cobras would all be considered as friendly. However, all of these aircraft are present in the Iranian military inventory. Furthermore, Egypt and Finland use Soviet built MiG-21 Fishbeds, and French made weapons can be found almost anywhere. There are countless other examples. An assessment of whether a vehicle or aircraft is friendly or hostile is more accurately made when you have identified it and you have knowledge of its foreign use within your area of operations.

Data overload is an always present danger in identification study and training. Trying to learn too many vehicles is one way to become overloaded. Concentrate on only those that are likely to appear in your area of operations. Furthermore, learn the basic types before trying to learn variants. This is especially important when learning or teaching Soviet equipment. Identification training should be a building process. Always start with a solid foundation. Overload can also occur when too much new information is presented during a cram session. It is far more productive to present a 1-hour identification class on a couple of vehicles every week than a 4-hour class on every vehicle once a month.

Do not simply memorize a few small features on a vehicle or aircraft to identify it. These features may become obstructed from view or even removed or replaced during modification. Some examples are smoke grenade launchers, armor skirts, storage boxes and antennas.

Question your sources. Not everything you read in every book or magazine will be correct. Always doublecheck the information with other sources.

Teaching Techniques

The most basic and useful teaching aids for vehicle identification training are slide photographs. But because it is nearly impossible to obtain good color slides of the most modern equipment, it is better to make them yourself. This can be accomplished by either taking photographs of the actual equipment or by photographing the pictures in books and magazines with slide film. Although making slides of pictures sounds easy at first, it does require some special equipment that can be found in most photo craft shops. You will need a 35 mm camera, a copy stand (or any similar lighting arrangement) and close-up lenses. Some lighting and film combinations will require the use of a color filter to ensure correct color reproduction (normal tungsten lights with Ektachrome 200 film requires a blue filter number 80A).

Although the techniques and pitfalls discussed apply equally to self-study and classroom instruction, there are many more effective techniques that can be used to keep threat training interesting and productive. One of them is called "blackboarding." Blackboarding is the use of rough sketches to reenforce, or even test, identification knowledge. It begins with a thorough presentation of the subject vehicle using photographs and/or slides. The instructor then draws a sketch of the subject on the blackboard. You don't have to be an artist to use this technique. A rough sketch will tend to exaggerate the major identification features of the subject. Later, the students can be called upon to make their own sketches either on the blackboard or on a piece of paper. This technique is most effective in aircraft identification training.

"Role playing" is a technique that is most effective when used with a group that is weak in identification knowledge. At the beginning of the class, each student is given a card from GTA 17-1-13 (Armored Vehicle Recognition Cards) or GTA 44-2-10 (Aircraft Recognition Playing Cards), or a reasonable facsimile. (GTAs are available at Army Training Aid Centers.) They are told that the vehicle they are holding is "their" vehicle and they must call out the name of their vehicle when a slide picture of it appears during the class. The instructor precedes the instruction on each vehicle with a slide of the vehicle to be discussed. Ample time is given for the student to recognize the vehicle and call out its name. If the student fails to recognize the vehicle, the instructor identifies the vehicle and the student holding the card. This technique compels the student to compare each vehicle shown with the one he is holding for similarities and differences.

Scale models can be used in threat training by combining them with terrain boards during a situation training exercise. This technique can either be used in a classroom where students observe the terrain board and models from the far end of the classroom; or the terrain boards can be placed a distance away from parked aircraft, with the aviators observing through optics; or the aircraft can actually hover to an observation/firing position where the aviators unmask and observe the models at a distance. Other training elements such as spot reports, calls for fire, range estimation and threat weapon's capabilities also can be integrated.

Summary

Like any other training, how well the soldier responds to threat training depends on how well the instructor knows the subject and how interesting it is presented. The former is best accomplished through constant self-study. The latter, however, is only limited by the imagination.

the Grafenwoehr Effect

CW2 William B. Swears
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U.S. Army Aviation Center
Fort Rucker, AL

ON 17 APRIL 1985, I, a young warrant officer (WO1) on my first pilot in command (PC) mission, inadvertently flew into instrument meteorological conditions (IMC) while returning from Grafenwoehr to my home station of Goeppingen, West Germany. I lived through the experience, and returned to Grafenwoehr with an undamaged aircraft. Virtually every year, someone is not so fortunate.

I set out from Grafenwoehr, in an OH-58A Kiowa, with a nonrated passenger in the left seat and a forecast of greater than visual flight rules (VFR) minimums en route. I had been warned of the possibility of patchy fog in the hills southwest of Grafenwoehr but was told that, once clear of the hills, the weather would be good. Grafenwoehr Metro made the initial forecast. As I would be launching at 1830 for Goeppingen, I called the Army flight operations detachment (AFOD) in Heidelberg for an update before launch. (Grafenwoehr weather closes at 1700 hours.)

On takeoff from Grafenwoehr, weather seemed as forecast. However, as I followed the corridor west-southwest toward Neukirchen, it became apparent that I would not be able to maintain my minimums en route. (Uncontrolled airspace minima for nontactical flight in U.S. Army, Europe (USAREUR) are 500-foot ceilings and 800 meters visibility; our unit standing operating procedure (SOP) required 1,600 meters visibility, about 1 mile.) I was also having trouble staying in contact with Grafenwoehr tower. I changed routes and left by the Amberg (south) corridor. Weather was still a little worse than forecast to the south. I decided to follow the Autobahn toward Nuernberg and out of the hills.

About 15 kilometers out of Amberg, midway between Amberg and the Feucht intersection, the Autobahn enters a cut in the hills and continues down into the Nuernberg valley. On entering this cut, I observed fog on either side several hundred meters out. This seemed no factor as I had plenty of room to maneuver and could see at least 3 kilometers along the Autobahn. I flew about 10 kilometers in these conditions while waiting to break out of the hills and into the clear weather AFOD had forecast.

Near the Poppberg intersection, fog from the sides started to close in. Still unworried, with double the SOP, 1,600 meters visibility to the front, I slowed to 60 knots and descended to about 200 feet above ground level. Abruptly, the Autobahn in front of me started to vanish and visibility to the sides dropped dramatically. Immediately, I entered a descending turn. About half way through the turn, I entered IMC.

After initiating the inadvertent IMC procedure as set forth in the USAREUR Supplement 1 to AR 95-1, *Flight Regulations*, I discovered that I could not communicate on any guard frequency. (This commo failure was due to poor avionics. The aircraft was returned to Coleman Barracks for avionics work after return to home base.) About 5 minutes later, I regained contact with Grafenwoehr tower on my FM radio. Because I no longer trusted my radios, I continued on the "copter only" nondirectional beacon approach I had planned while flying without communication. After 35 minutes IMC, we broke out of the clouds on final into Grafenwoehr.

On landing, I forgot to drop my passenger at the VIP pad. He didn't seem to mind. Later, the colonel claimed not to have been aware that we had an emergency that day and that the only indication he had of anything unusual was the altimeter needle going around and around during the climb. That is a polite fiction, as few colonels are accustomed to obeying orders snapped at them by overstressed WO1 pilots. Without the colonel's calm support and professional manner, this young WO1 might not have landed safely that day. As it was, we both spent 35 minutes pretending everything was business as usual.

Had I pushed too hard? European weather is often poor, and we become accustomed to flying at minimums. It is possible that I was simply overconfident and blundered into a fogbank. I assumed that this was

The author next to an OH-58C Kiowa.

exactly what happened that day for several years. But the picture of that Autobahn fading away haunted me. It did not look as if I flew into the clouds. It seemed as if the fog suddenly closed in around me.

I have landed often enough to avoid flying in adverse weather. I did not, at the time, think that things had grown so critical I would be unable to maintain visual conditions while turning at my reduced airspeed. As a result, I entered IMC at 50 knots indicated airspeed, a 45-degree bank angle, 50 feet above the ground.

I tried and convicted myself. I had pushed too hard. I felt double foolish because I tend to preach about there being no old, bold aviators. I spent 3 years telling other young aviators, and experienced aviators, and anyone else who wouldn't run away, or who I could keep up with, about tunnel vision and the dangers thereof. I talked about the danger of concentrating on a linear target, such as the Autobahn I was flying over that day. It was such an obvious landmark, I said and believed, that I missed the fact that the world was turning gray around me until it was too late. I decided I must have flown into thicker and thicker fog without realizing it until my one big, black landmark vanished. But the picture of 3 kilometers of road disappearing within 100 meters of terrain stayed with me.

In July 1988, I was flying nap-of-the-earth cover at Ft. Rucker, AL. We received a weather advisory of fog at 0100 local. A weather recall was initiated by the individual classes for a midnight downtime. I had no paperwork to complete as I was not the PC that night, so I was on the road back to Enterprise, AL, at 0015 and found myself driving in a thick fog. This was 45 minutes before the forecast fog arrival, and the advisory had been for 1-mile visibility. I was in about 200 meters visibility. How fast, I wondered, can fog form? I could remember flying over the area I was now driving through only minutes before with several miles visibility while listening to Lowes' instructor pilots complaining about the unnecessary precautions we were taking. Everyone got in VFR that night.

Still, how fast can fog form? I spoke to Second Lieutenant Frye and Master Sergeant Triplett of Detachment 9, 5th Weather Squadron, Cairns Army Airfield. Lieutenant Frye stated that fog can form and get thick in a matter of minutes at Ft. Rucker. He also gave me a quick rundown on what causes fog formation: First, temperature and dewpoint being close or equal; second, winds from 3 to 7 knots (less than 3 knots doesn't allow sufficient mixing; more than 7 knots causes the moist surface air to mix with drier, upper level air); third, some form of condensation nuclei called hydrometeors.

Normally, fog takes several minutes to form, which would not explain what I thought happened to me. However, after several years of thinking about that experience, and 45 minutes' meteorological and physical research, I have developed a theory that may explain that what happened that day is predictable and can be avoided by the observant pilot.

Let's model a theoretical situation wherein local winds can be considerably greater than predominant winds. Let's say that an OH-58A is flying west, into a headwind, down a narrow valley that opens out into the Nuernberg valley. Visibility is good, although outside the valley there is fog. Forecast winds for the area are out of the west at 5 knots. If the mouth of the valley were 600 meters across, and it narrowed to 200 meters across, it could cause the wind to funnel in and increase in speed. The weather people call this the venturi effect turbulent mixing. It often happens in valleys that parallel the winds. The top of the valley being open, there is some loss, but overall it could easily double the wind velocity. This usually causes turbulence and must have the other effects common to venturi systems.

First, the increased velocity must lead to some loss of static pressure and a corresponding increase in dynamic pressure. Second, the air

being lost over the top of the valley would tend to push the surrounding, foggy, air mass away, creating a closed tube leading up from the Nuernberg valley, which was clear. Third, the air in the valley must have cooled considerably as it accelerated and climbed into the hills.

It should be noted that this cooling would probably have caused fog to form in the valley if the moisture level were great enough. In fact, whereas the predominant visibility had been forecasted at several kilometers, and Grafenwoehr was at that time enjoying at least 7 kilometers visibility, the visibility in the valley was about 3 kilometers.

Two interacting conditions caused the sudden development of fog around my aircraft that day. First, the cooling of the air as it blew up from the Nuernberg valley. Second, the predominant 5-knot wind velocity dropped off just a couple of knots. It seems likely that the reduction in dynamic pressure caused by the decreased wind velocity would force the localized low pressure area within the valley to stabilize. Air flowing in from above and the sides to fill this low pressure tube would already carry visible moisture. In short, this tube of relatively clear air would collapse.

A last possible contributing factor in the sudden fog formation I experienced should be mentioned. If fog formation requires winds of 3 to 7 knots, and the accelerated air in the valley was at 20 knots, a reduction of 2 1/2 knots in the predominant 5-knot winds might have led to a localized 5-knot wind within the valley. (Reducing the predominant windspeed by 50 percent would have the effect of reducing the accelerated winds in the valley by 50 percent.) This effect probably was not significant as when the winds were higher (thus causing mixing with upper air masses); they would have caused mixing with low lying clouds.

I might have gone inadvertent because I was ignorant of a localized type of weather phenomena. Every aviator knows what the venturi effect is, at least on nodding terms. We even know it happens in valleys, although we seldom think of it as the venturi effect. Primarily, we think of it as a source of turbulence.

The day I popped into the fog, I was flying in what turned out to be a widespread, unforecast weather condition. I was flying along a narrow, reasonably shallow cut in the hills within a localized tube of clear weather, caused by the introduction of an airstream from a lower, drier area. This tube collapsed abruptly when conditions changed. Suppose I was in a deeper valley making that turn when the world turned gray?

There is a great deal of debate in the Army today concerning whether it is possible to go inadvertent IMC without pushing beyond the conditions outlined in AR 95-1. While examining the reported inadvertent IMC incidents between 1980 and April 1988, I found two primary weather phenomena cited that can apparently catch an aircrew off guard.

First, the one I just described. This one can be avoided. If you find yourself dodging patchy fog, and see an inviting valley, think about the direction of the predominant wind. Is it really patchy fog? Or is it an area effect that was unexpected? If you find yourself with unexpected fog out your right window, unexpected fog out your left, and a clear path down a narrow valley in between, take the time to figure out why that one area exists. If you can't see why it's there, don't plan on it lasting.

A second frequently cited cause of inadvertent IMC occurs while flying in falling rain or snow. It becomes difficult, or impossible, to see areas that may lead to drastically reduced visibility. In addition, the precipitation may simply increase enough to cause IMC. Those who have driven in Texas have seen rain fall so hard they have had to stop their cars because they couldn't see. In the sky, it's hard to just pull over and stop.

I have a method of avoiding this situation. If weather is forecasting thundershowers or areas of heavy precipitation, I don't go up there. If these areas are forecast as isolated, but there is a predominant ceiling or visibility condition that could prevent my seeing them in time, I don't go up there, even if it means canceling the flight.

I'm not writing this article because I was a faultless victim. I made mistakes that day. As a result, I am a more conservative pilot and it is unlikely that I could be caught that easily again, even if I never understood what really happened. And yet, how many aviators with the type of poor weather flying experiences that Germany, at least, affords will really drop the mission when they have 2 miles' visibility in front of them and meet the legal minimums?

The two conditions I listed above can and will lead to inadvertent IMC. Being aware of the possibility may prevent you from doing what others have done and may prevent a Class A accident, with you as the victim. Between 1 January 1980 and 5 April 1988, 38 reported rotary-wing aviation mishaps involved inadvertent IFR/IMC in forecast VFR conditions. Ten of these were Class A mishaps.

So, how many aviators have jumped into that convenient, fog-free valley and continued to march? How many of those fatalities were caused not by the pilot flying into IMC, but the IMC reaching out to touch the unsuspecting pilot?

Other specific phenomena can also lead to inadvertent IMC. If you have experienced an unforecast weather incident involving inadvertent IMC, and feel the lesson you learned may prevent someone else from experiencing the joys of accidental instrument flight, please contact the U.S. Army Safety Center. This information could be of potential safety and training value.

Major Rick D. Hancock
Directorate of Procurement and Production
U.S. Army Aviation Systems Command
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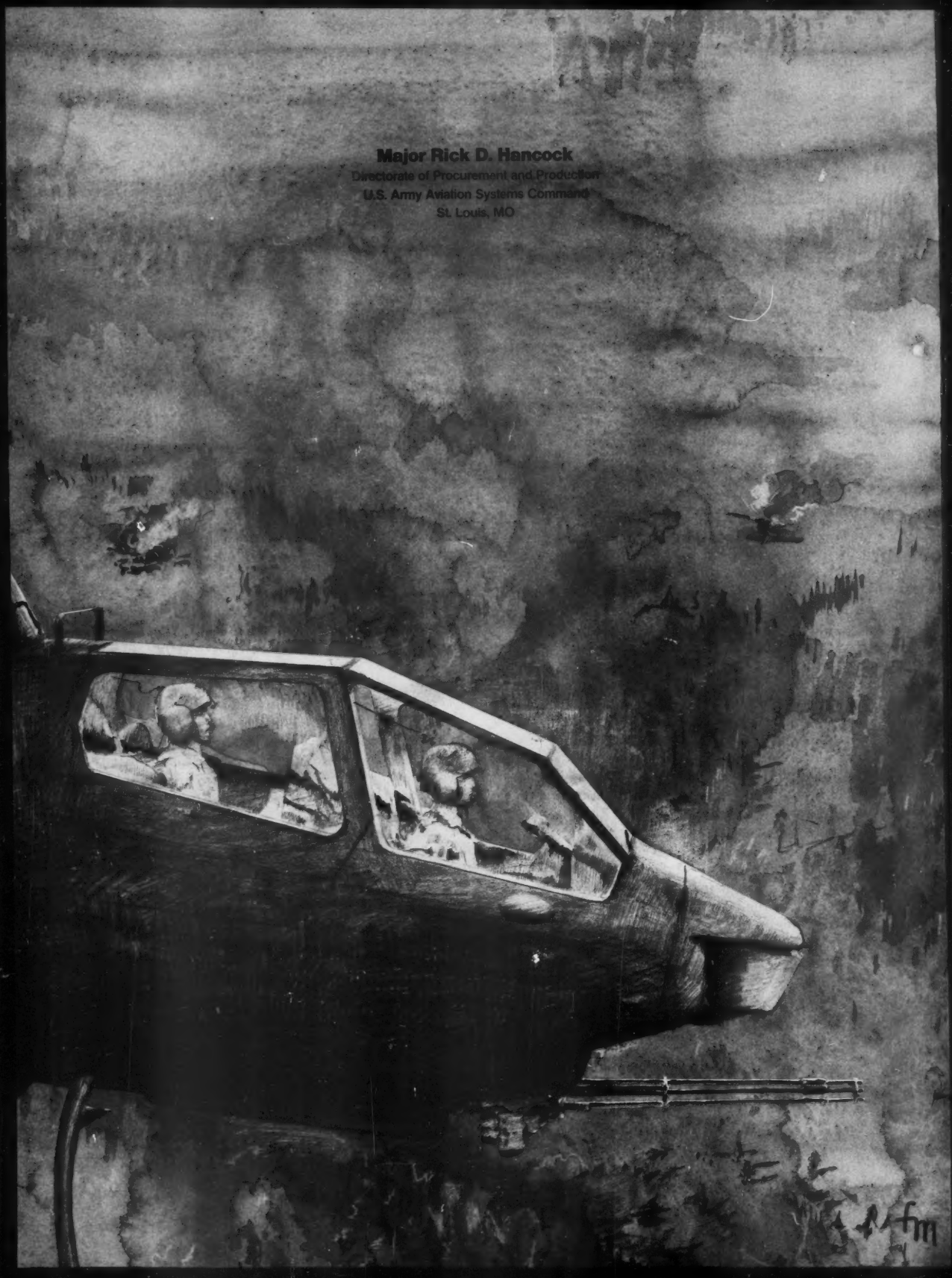


Division Attack Helicopter Deep Operations

AS THE ARMY transitions to the Army of Excellence force structure and applies AirLand Battle (ALB) doctrine, divisions are undertaking to adopt the key elements of changes in doctrine, organizations and equipment. Many divisions have only mechanically reconfigured to J-series tables of organization and equipment and are still thinking like H-series units. They have yet to master their new capabilities and project them properly into the operations for which they were designed.

With our new divisional aviation brigades, the Army Aviation community must educate all members of the division team on its new capabilities and employment possibilities. Provided is an instructional primer for using the currently fielded divisional AH-1 Cobra attack helicopters in the deep attack mission.

General

Division attack helicopter deep attacks are high-risk operations. Enemy capabilities make crossing the forward line of own troops (FLOT) and penetrating beyond it a matter of significant concern. They are often an all or nothing affair. The commander cannot regard the deep attack as a routine operation but must assess the risk to the attacking force in relation to the effects on close operations and counterattack plans.

Purpose

The deep operation is an integral part of ALB and must be included in the planning of all phases of the battle. In deep operations echeloned Threat forces are attacked to delay their closing rate and disrupt command and control (C^2) to forestall concentration of their forces and inhibit their ability to influence or threaten the division's close operations.

Threat

Our attacking formation will face an integrated air defense (AD) system comprised of both offensive and defensive weapons. Attack helicopters, interceptor helicopters and close air support (CAS) will constitute the air-to-air threat. Ground based AD weapons will include surface-to-air missiles; AD artillery, such as the ZSU-23-4; infantry support weapons, such as the 30 mm gun mounted on the BMP (Russian infantry combat vehicle); and the 12.7 mm machinegun mounted on most other vehicles. Also, our attacking formations can expect to be subjected to all forms of radio electronic combat and both natural and man-made obscurants.

Targets

Only targets of the highest possible mission value (high-value targets), and whose loss will substantially degrade enemy capabilities, warrant the risks inherent in conducting a deep attack. Target value analysis may identify either point-terrain-oriented or force-oriented targets. In the offense, probable targets are the intercepting and blocking of reinforcing units and preventing the escape of fleeing units. In the defense, probable targets are the separating and disrupting of attacking second echelons and destroying pinpointed C^2 centers (i.e., second echelon regiments of first echelon divisions or the first echelon regiments of second echelon divisions).

Attack helicopters should be regarded primarily as antitank systems. An attack helicopter battalion (ATKHB) armed with a full complement of TOW

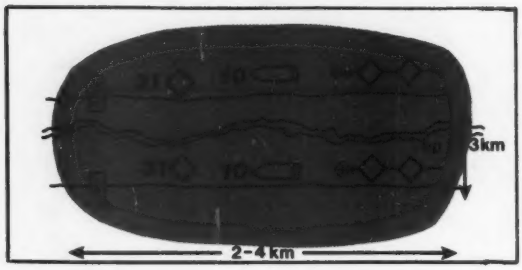


FIGURE 1: Battle array.

missiles can reasonably expect to engage a second echelon tank regiment and defeat a tank battalion if the enemy is moving in the open and it is daylight. This represents the maximum capability.

Engagement areas (EAs) should be selected based on density of targets, advantages offered by the terrain (i.e., bottleneck areas blocked by barriers or battlefield air interdiction (BAI)) and their distance from the assembly area of the attack battalion. Obstacles and interdiction efforts will then focus on channeling the enemy into the selected area. Aircraft endurance factors dictate that the EA most likely will be 5 to 30 kilometers (km) from the FLOT. Implications of EAs beyond that distance are addressed later in *Mission Coordination and Planning*. Threat second echelon regiments can travel two or three roads as they advance. In this configuration, the Threat is arrayed in sufficient density to occupy an area small enough to optimize the lethality of an ATKHB. Terrain should provide for engagements at ranges beyond 3 km, concealed firing positions and adequate control measures (figure 1).

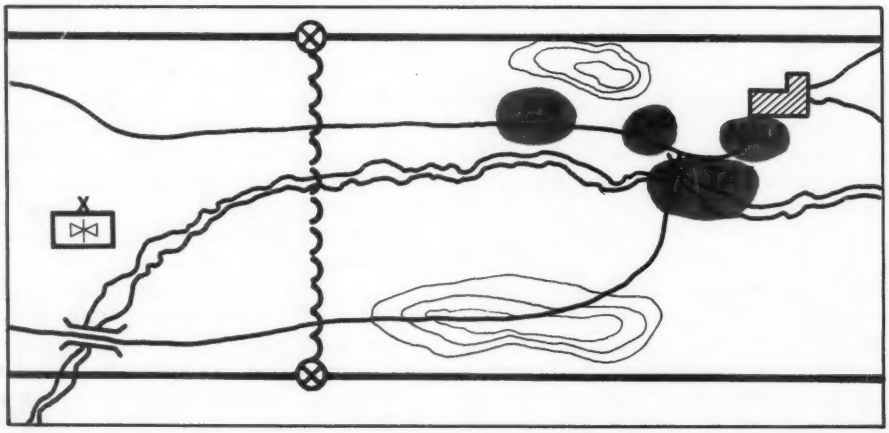
Timely intelligence and target information are critical to this type of operation. Early identification of the targeted unit and timing its arrival at the EA exceed the capability of the division's military intelligence (MI) battalion, which is limited to 30 km past the FLOT. Corps side looking airborne radar and sensor assets are required to provide this information.

The decision cycle for developing the decision-support template for this operation includes the enemy rate of march, named areas of interest, decision points, time to process the information and time en route to the EA. Target areas of interest will be beyond the range of divisional weapons but should be planned for BAI (figure 2).

Aircraft

Figure 3 shows the performance parameters of the currently fielded aircraft. Corps and Air Force aircraft such as OV-1D Mohawk, RV-1D, F-111, EC-130, and RC-12 are equipped with electronic warfare application to support deep attack.

FIGURE 2: Decision support template.



	MAXIMUM ENDURANCE	ARMS	SPEED
OH-58C	2+15	none	90 knots
UH-1	2+15	2-M60	110 knots
UH-60	2+00	2-M60	145 knots
AH-1	1+50	8-TOW 500-20 mm 14-rockets	132 knots
EH-1	2+15	none	110 knots

FIGURE 3: Division aircraft.

Mission Coordination and Planning

The ATKHB commander should plan the deep operation in coordination with the fire support officer, air liaison officer, MI battalion commander and division Army airspace management and control (A^2C^2) element. Mission planning includes the following four phases:

Staging the attack. Based on the target analysis, threat positions and distance from the ATKHB's assembly area location will dictate the composition of the attack force. Considerations are—

- Selection of aircraft must support the mission but consider the limitations of each. Scout aircraft have no armament and are too slow to keep up with the AH-1; they should not normally cross the FLOT. Command and control UH-1s have limited armament but also lack the speed to keep up with the AH-1; they should not normally cross the FLOT. The UH-60s have the speed to match the AH-1. Although not normally configured for C^2, UH-60s are the primary choice to cross the FLOT.
- Logistical support is based on the axiom that a helicopter is never more than 2 hours from being useless. This endurance limitation restricts our ability to conduct operations to within 30 km beyond the FLOT. A forward arming and refueling point (FARP) will be required beyond the FLOT for operations beyond 30 km. If a FARP can be used at all, it can be emplaced by the UH-60, which can each carry two 500-gallon blivets and operators. These aircraft may cross the FLOT with the AH-1 but are required to fly slower and higher than normal. In this instance, the AH-1 will provide escort services to the FARP location. Refueling can occur either before or after the attack is conducted. Stinger teams should be attached for limited security and the FARP should exist only long enough to replenish the force.

Penetrating the FLOT. Primary considerations for determining the location of the penetration are threat disposition and any advantages of the terrain that can be used to conceal the formation from detection. Control measures will understandably have to be very tight. Routes, the most restrictive movement control measure, are required to maintain flight discipline, aid navigation and reduce exposure to the enemy. Radio silence is desired to preclude enemy interception and identification. The unit forms at a start point (SP), traverses a route, crosses the FLOT at a passage point (PP) and continues to a release point (RP), where they deploy for the attack.

Although the planning cell has completed the necessary coordination, a liaison officer from the aviation brigade should be assigned to the unit occupying the selected crossing sector. The liaison officer's presence at the PP will eliminate confusion on timing, recognition signals and radio frequencies.

Phase lines should be used on complex missions requiring the coordination of multiple air units. For these missions, a C^2 aircraft will receive the position reports and provide updated intelligence information.

Joint-suppression of enemy air defense (J-SEAD) operations are designed to neutralize, destroy or temporarily suppress enemy AD systems for a specific crossing operation. They engage the entire enemy AD system from the FLOT to several hundred kilometers to the enemy's rear. Division organic systems will place fire on and jam close targets, but must be coordinated to obtain benefits from the theater J-SEAD plan. The joint force air component commander develops the plan and integrates the use of air, artillery and special operations forces against enemy AD capabilities.

Major emphasis is placed on integrating organic systems into the penetration plan and providing a deception plan. The electronic warfare capabilities of the combat electronic warfare and intelligence battalion are the primary systems for deceiving the enemy at multiple locations on the FLOT by disrupting his acquisition systems and allowing our crossing undetected.

Preferably a PP can be found at a break in the FLOT. Planners should seek opportunities to perform crossing by stealth. An irregular FLOT

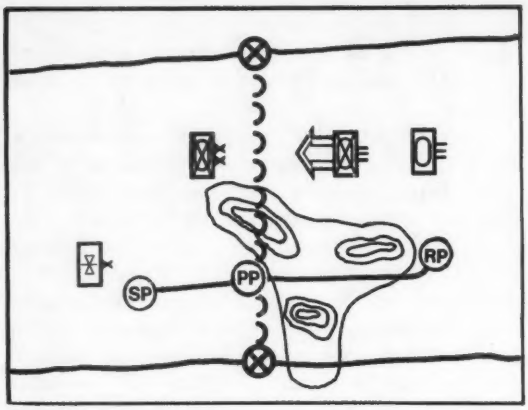


FIGURE 4: Crossing by stealth.

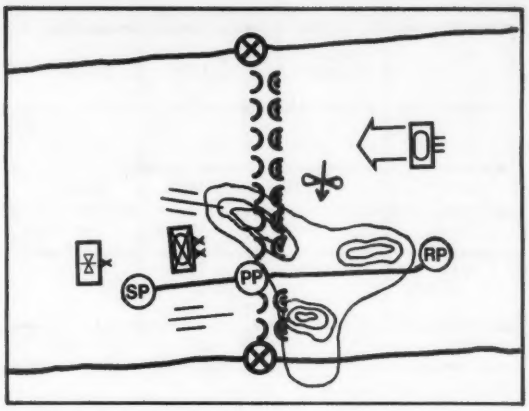


FIGURE 5: Pentration by force.

contains gaps in enemy AD deployment that, coupled with the use of terrain to mask movement, reduces risk to the attacking force (figure 4).

When the enemy has established an interlocking AD belt, penetration by force will be required. Division organic weapons conduct coordinated suppression of the enemy acquisition and weapons systems to open a passage point (figure 5).

Conducting the attack. The aviation brigade commander formulates the attack plan based on the characteristics of the EA. Scatterable mines delivered by either BAI or long-range artillery should be included in planning from the beginning. Aircraft endurance will not allow time for conventional standoff engagements but will instead require attack techniques that emphasize surprise and overwhelming fire. An ATKHB will normally use the mass attack technique with three companies. Each company is given a sector in which it operates autonomously; optimizing weapon effectiveness and concealment offered by the terrain. Natural features (rivers and wood lines) and roads and power lines provide the best means of designating sectors. An easily identifiable RP is selected close to the EA. At this point, the formation breaks up and proceeds to the EA under company command. Surprise and mass destruction are the best insurance of success. In the absence of scout OH-58s, each company will designate aircraft to warn of approaching enemy air or ground units.

Critical timing and projection variables dictate that the flight commander must be prepared for the possibility that the target is not always present when he arrives at the EA. Station time and the value of the AH-1 as an asset will not permit the luxury of open hunting. Priorities for secondary targets must be established during the pre-mission planning upon which the flight commander can base his decisions.

Night operations and adverse weather are major limiting factors for all division helicopters. Night vision devices aid in the pilotage tasks of obstacle avoidance and navigation, but flight crews are forced to fly both higher and slower—both adjustments increase their vulnerability. The AH-1 has an illuminated reticle in the telescopic sight unit, but the target must be visible. Weather is the one uncontrollable factor that can prohibit execution of the mission. Emphasis must be placed on receiving continuous weather updates from units throughout the division area.

Recrossing the FLOT. The attacking force will break off the attack and regroup for the return flight. A different route should be selected from that used inbound. Planning considerations remain unchanged and all J-SEAD operations are repeated. Control of the J-SEAD should be based on a timetable with the provision for the flight commander to execute it based on actual requirements.

This primer is easily adaptable to all divisions and provides the substance of the division attack helicopter deep attack concept and execution. Once modified to specific divisional configurations, it can provide the medium for the education challenge and a model for instruction on other aviation brigade missions.

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USAASO SEZ

AVIATION MAPPING, CHARTING AND GEODESY ISSUES

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THE U.S. ARMY Aeronautical Services Office (USAASO) continues to work on mapping and charting issues for the Army aviator:

Visual flight rules (VFR) helicopter route charts—The production of helicopter route charts continues according to Interagency Air Cartographic Committee specifications. These charts show the areas of Boston, MA; Chicago, IL; Los Angeles, CA; New York, NY; and Washington, DC. Route chart production is based on the number of aircraft movements and how they affect airport traffic in high density areas. At some locations, the number of individual letters of agreement between airport authorities and route users identifies the airport and that area as a possible candidate for a VFR helicopter chart. Route and associated written information outlines procedures on an easily readable chart. USAASO ensures that Army units in the area of chart coverage receive the correct chart from their Defense Mapping Agency (DMA) automatic flight information publication distribution account. The chart coverage also includes those units within 250 nautical miles of the coverage area.

Large and medium scale map design review—In 1988, USAASO conducted an Army Aviation review of the DMA prototype topographic maps and for air and ground joint operations graphics using a 1:50,000 through 1:250,000 scale. Army Aviation personnel evaluated these maps and USAASO consolidated and forwarded the comments to DMA. Major areas of concern: blue/green and red light readability; contour intervals; depiction and labeling obstructions; and increasing the use of universal transverse mecator grid designators on the map's face. Users like the new features: yellow highlighting of military grid reference numbers and no margins on the top and right edges of the map sheet. The North Atlantic Treaty Organization (NATO) community is reviewing map specification changes.

Standard DMA 1:100,000-scale topographic maps—This scale topographic map, requested by Army Aviation and validated as a requirement by USAASO, was included in the NATO review. This scale map will provide the aviator with an in-the-cockpit standard map instead of using 1:50,000-scale map sheets. Note: One sheet depicts the same area as four 1:50,000-scale sheets. DMA produces the 1:100,000-scale map coverage outside continental United States (OCONUS). Ft. Rucker, AL, and Ft. Hood, TX, have been the only posts in the CONUS to formerly ask for the 1:100,000-scale map coverage for their operational training areas. USAASO, in turn, validated and sent the requirements for this scale map coverage to these two posts. USAASO has requested that major Army commands identify area coverage requirements for CONUS. In addition, USAASO will initiate an Army review to determine suitability for U.S. Geological Survey 1:100,000-scale maps as an interim substitute for required standard DMA maps.

USAASO invites your questions and comments and may be contacted at AUTOVON 284-7773.

U.S. Precision Helicopter Team

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CW4 John E. Loftice CW2 Kenneth W. Wright	SSG Bruce L. Snyder	2
CW3 James R. Church SGT Scott A. Harbarger	SSG Milton G. Turner	3
CW3 George W. Egbert CW3 Paul W. Hendricks	SSG Andres Hernandez	4
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CW4 Maris Stipnieks 1LT Brian W. Dickens	SSG Steven J. Martin	7
CW3 David L. White 1LT Jae D. Collins	SSG Daniel Balderrama	Demonstration Crew

U.S. Precision Helicopter Team Wins World Helicopter Championship

Chantilly, France 7 to 10 September 1989